POPULAR SCIENCE

FOUNDED MONTHLY 1872

OCTOBER

25 CENTS

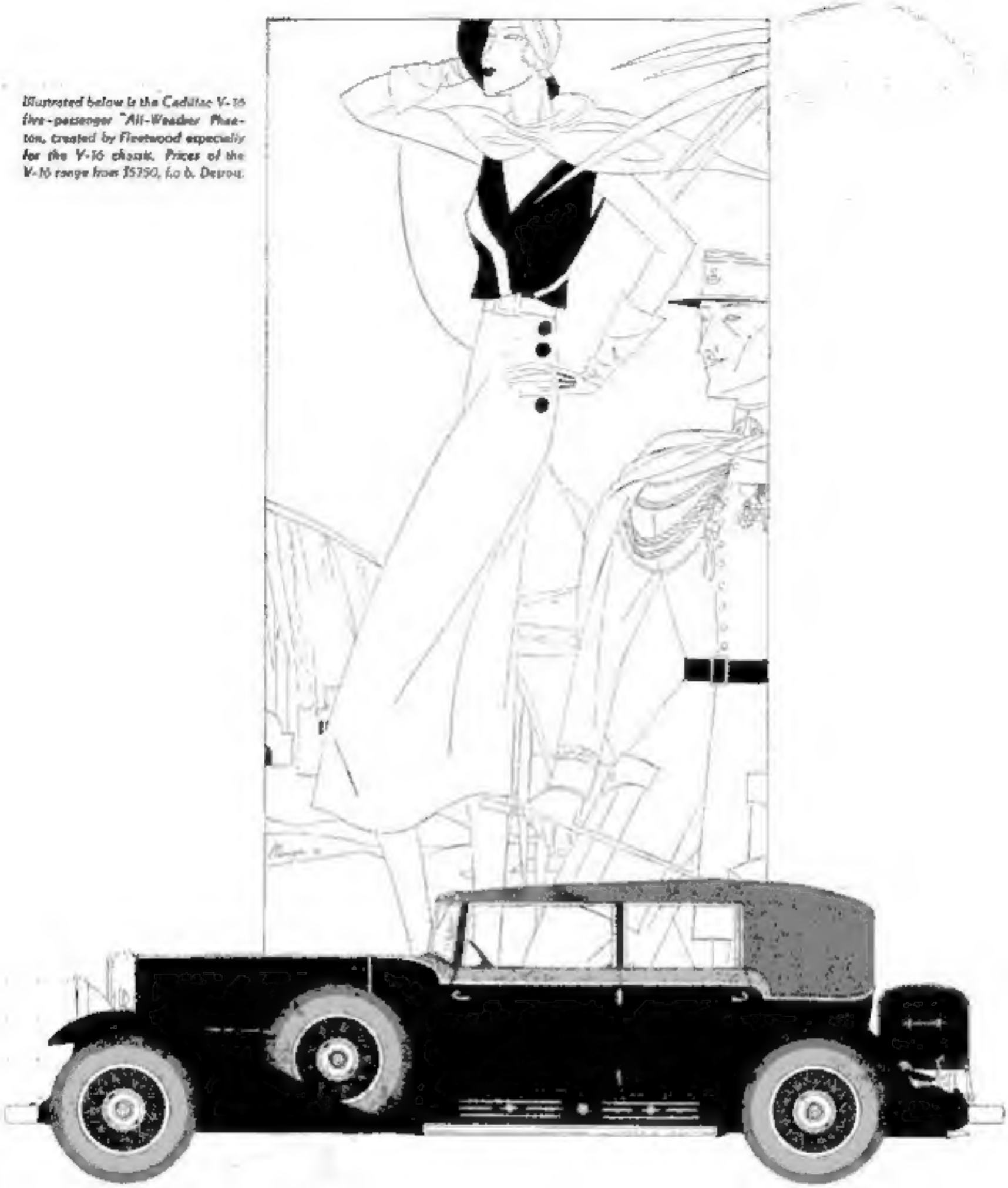
UNCLE SAM'S NEW MOTORCYCLE CAVALRY

Page 52

It's great to have a dad who knows

Dill's Best SINCE 1848 is America's Best

Illustrated below is the Cadillac V-16 five-passenger "All-Weather Phaeton, created by Fleetwood especially for the V-16 chassis. Prices of the V-16 range from $5750, f.o.b. Detroit.



To sit at the wheel of the Cadillac V-16 is really an exceptional experience—for there is no precedent at all for **what this car does**, nor for the **manner** in which it does it. The V-16 was planned, of course, as an entirely new embodiment of motoring luxury; and not a single tradition or limitation was permitted to influence its design. As a result, it is a highly individualized creation—a car so irresistibly inviting in appearance, so superbly behaved in action that it must inevitably revolutionize your highest opinion of motoring. Lest we seem overly enthusiastic in the telling, may we suggest that your Cadillac-La Salle dealer will gladly arrange to demonstrate the truth of these statements?

CADILLAC V8 V12 V16

25 Cents a Copy
$2.50 a Year

POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

Table of Contents for October, 1931

LEADING ARTICLES

FEATURES AND DEPARTMENTS

ASTRONOMY

AUTOMOBILES

AVIATION

HEALTH AND HYGIENE

MODELS

October, 1931, Vol. 119, No. 4. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Nine months' subscription in U. S., $2. Twelve subscriptions to United States and its possessions, $2.50; foreign countries, including Canada, $3.

Popular Science Monthly for October, 1931

How to Read a Balance Sheet

One Way Average Investors Can Judge The Value of Present or Proposed Investments

By LEON MEADOW, *Financial Editor*

FRED HOBART, Advertising Manager of a large publishing house, walked into Walter Barnett's office and said, "You're an accountant, Walter—tell me, is it necessary or worthwhile to analyze a balance sheet before making an investment in a company's securities? I've been thinking about investing in the General Sample Company—and I have their last balance sheet with me now."

"I don't know how necessary it is," his friend replied, "but analyzing a balance sheet would certainly go a long way toward helping you decide on the merits of any company's securities. Before making an investment in a security, be it a bond, preferred or common stock, you should know what kind of a company is behind the security, what its business is, its history, management, methods, earnings, outlook and possibilities for development. And, as one of the most important things, you should also know its financial condition. For this last purpose you must make a thorough study of the company's balance sheet. This will give you a diagnosis of the company's financial condition as it is at a given moment. It does not cover a period of time, as an earnings statement does, but shows you what the company owns and owes at a given moment.

"Of course it requires a certain amount of elementary accounting knowledge to extract the actual facts out of a balance sheet—or to read it properly—but with a little common sense the average man should have no difficulty in forming a pretty accurate picture of a company's financial condition, after studying its balance sheet. Various complications are possible, but, essentially, each balance sheet is divided into two major parts—namely 'Assets,' on the left side and 'Liabilities' on the right side. The difference between the two, or the excess of assets over liabilities represents the capital and surplus of the company—or its actual worth in terms of the present interest of stockholders in the assets of the company. So much for generalities. Now let's have a look at the balance sheet of the General Sample Company."

Fred put it down on Walter's desk and said, "Show me how to read it. You know I'm a dub on the simplest figures—and this sort of thing staggers me completely."

Barnett picked up the balance sheet, reproduced below:

ASSETS

Plant and Property	$ 421,466
Patents and Good Will	102,000
Cash	50,665
Mortgages Rec'vable (1936)	10,000
Notes Receivable	65,400
Accounts Receivable	174,381
Accrued Interest Receivable	2,520
U. S. Gov't Securities	15,000
Other Securities	34,620
Inventories	143,703
Bond Discount and Expense	17,305
	$1,035,060

LIABILITIES

Notes Payable	$ 23,500
Accounts Payable	38,421
Accrued Wages and Int. Payable	3,067
Reserve for Federal Taxes	8,603
Reserve for Depreciation	43,171
1st Mort. 4½% Bonds (1948)	250,000
7% Notes Due Jan. 1, 1931	25,000
7% Cum. Pref. Stock (2,000 shares, $100 par value)	200,000
Common Stock, 20,000 shares, $10 par value	200,000
Surplus	161,797
	$1,035,060

"To begin with," he said, after studying it, "you must make a proper distinction between fixed and current assets, and between fixed and current liabilities. Fixed assets are those of a permanent nature, like real estate, claims or investments, not readily saleable or collectable. Fixed liabilities are debts which don't have to be paid until after more than a year. Current assets are those which can be quickly marketed or collected within the coming year. Current liabilities are debts which the company must pay within not more than a year from the date of the balance sheet.

"This distinction between fixed and current assets and liabilities shows you whether or not the company is strong enough financially to take care of its immediate or early obligations. We'll start by assembling the current assets and liabilities." Walter picked up a pencil and wrote down the following:

ASSETS

Cash	$ 50,665
U. S. Gov't Securities	15,000
Notes Receivable	65,400
Accrued Int. Receivable	2,520
Inventories	143,703
TOTAL CURRENT ASSETS	$471,669

LIABILITIES

Notes Payable	$23,500
Accounts Payable	38,421
Accrued Wages and Int. Payable	3,067
Reserve for Federal Taxes	8,603
7% Notes due Jan. 1, 1931	25,000
TOTAL CURRENT LIABILITIES	$98,591

"What does that tell you?" asked Fred, puzzled.

"It tells you," Walter replied, "that the difference between these two totals is $373,078—and that represents the *net* current assets of this company. For a $1,000,000 corporation this is quite large and, in itself, reveals a good financial structure. It also tells you that the ratio between current assets and liabilities is almost 5 to 1. In other words, this company has almost 5 times more current assets than it actually needs to meet its current liabilities. And, there again, is an indication that the liquid or current financial position of General Sample Co. is exceedingly strong. *(Continued on page 6)*

How to Read a Balance Sheet

(Continued from page 5)

"So much for the current assets. Now, let's look at the fixed ones. Go back to the balance sheet and you will see two items, Patents and Good Will, $100,000 and Bond Discount and Expense, $17,505—both of which can be disregarded as actual assets, as they are highly intangible at best. If the company fails, patents and good will may have no value whatsoever. Bond discount and expense is an item set on the asset side to offset the loss which will come when the bonds of this company mature at par value."

"I don't understand," interrupted Fred.

"Well, assume that a company only realizes $95,000 on the sale of bonds which they will have to redeem at $100,000 par value when they mature. That means a deficit or loss of $5,000—and to offset that and make the balance sheet come out right, they put down an item of $5,000—charging it to bond discount and expense—on the asset side. Actually it has no asset value.

"So, disregarding these two items, there are still three fixed assets left," continued Walter, writing as follows:

Plant and Property	$421,466
Mortgages Receivable 1958	10,000
Other Securities	34,620
TOTAL FIXED ASSETS	$466,086

"Now, to get the net total fixed assets, we have to subtract that $45,172 item of depreciation in the liability column—and then you have a net total of $420,914. Let's add the two and subtract the net current liabilities:"

Total net current assets	$471,669
Total net fixed assets	420,914
	$892,583
Less current liabilities	98,591
TOTAL NET ASSETS	$793,992

"And what does that prove, Walter? I still don't know whether General Sample is a good investment or not."

"I'm coming to that," Barnett continued. "Take the bonds first, as they have preference. You have $793,992 net tangible assets behind the outstanding $250,000 worth of bonds. That means there is over $3,500 in back of every $1,000 bond—and that certainly is ample protection for anybody's money.

"Now set aside $250,000 for these bonds and you still have $543,992 net assets left, next comes the preferred stock—which we'll assume can be liquidated at $100 par value per share. Divide the 2,000 shares of preferred stock into that $543,992 and you have about $275 for every $100 par value share of preferred stock. In other words, there is still 2¾ times enough money to cover the preferred stock, and there again is ample security. The total needed will only be $200,000, (2,000 shares @ $100 a share.) Subtract that $200,000 from the remaining $543,992 and you still have $343,992 assets left for the 20,000 shares of common stock—or about $17 assets behind each share.

"Now you have a pretty good picture of the financial condition of this company. Its bonds and preferred stocks are well protected, and if their yield at present market prices is attractive—I think you'd be safe in investing. And though I don't recommend common stock in any case—here you have $17 net asset value behind each share—and if you compare that with the present market price of the common stock, you can quickly tell how good or bad a buy it is for you.

"Now, Fred, this is a particularly favorable balance sheet. But if it had indicated that current liabilities equalled or exceeded current assets, this company's financial situation would be very shaky. And should the asset value behind each $1,000 bond be only $1,100—you could conclude that the bonds are a very poor risk.

"Of course," Walter Barnett continued, "the balance sheet is not enough proof of a company's financial position. The earnings statement is also of great importance—but that's another story in itself—a pretty long one—and—"

"And I've taken up enough of your time already," finished Fred Hobart. "Anyway, it's been a big enough lesson for one sitting, and I certainly have learned a lot of things I should have known, but never did. Some day, when we have more time, I'd like to learn about the value of an earning statement as an investment guide."

In reading or analyzing a balance sheet, it should be remembered that much depends on the particular character of the company. One doing exclusively a cash business does not need the same strong liquid position as a company doing a large credit business. There are numerous varieties, but we have tried to give a typical example which, if studied by the reader, should allow him to apply the general rules, with a certain amount of common sense, to many different situations.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 928 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McClure Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

AVOID
REPAIR BILLS
by using this
better OIL

THREE-IN-ONE is blended from three oils—*animal*, *mineral* and *vegetable*—for a definite purpose. Not merely to make it different from ordinary oils, but to make it *better*.

Because of its scientific blending, 3-in-One *cleans* and *prevents rust* as it *lubricates*. This triple protection adds years to the life of your tools and workshop equipment; saves many a bill for repairs and replacements. No plain mineral oil can ever supply as much protection.

Handy cans and bottles; good stores everywhere. Write for free sample and "Dictionary of Uses."

THREE-IN-ONE OIL COMPANY, DEPT. A-118
170 Varick Street, New York
260 Second Ave., Ville St. Pierre, Montreal

3-IN-ONE OIL

CLEANS - OILS - PREVENTS RUST

Cool Shaves!
I take 'em on the chin and like it!

THE 2 INGRAM BARBERS . . . TERRY TUBE OR JERRY JAR

"I MAY be shaky on Shakespeare but I'm genial with Gillette. And when the shaving brush comes up with an Ingram lather bubbling for action, I take it on the chin and I like it! Ingram's is

cool! Cool!! COOL!!!

"It's the coolest shaving cream that ever caressed my tough old cheek. It gives a quick kayo to the whiskers—it's as soothing as a shaving cream can be."

. . .

Coolness is the big Ingram feature in either package. Economical jar or convenient tube, each is crammed full of the same soothing, chin-charming cream. No smarts, no burns, no nasty nicks—nothing but coolness and comfort.

No other soap or cream can duplicate Ingram's chilly comfort!

INGRAM'S
Shaving Cream
IN TUBES OR JARS!

It just can't be done—because Ingram's has a scientific distinction that gives it its exclusive feature. We put in three special ingredients that make it cooler and smoother than any other shaving cream! And Ingram's is more than a shaving cream. For it feels on your cheek like a cream, a lotion and a tonic combined!

If you *need* proof of Ingram's superiority before you buy—proof you can have and have it free! Just fill out the coupon below and we'll send you ten cool Ingram shaves—absolutely at OUR expense! And if you like shaving comfort—you'll like Ingram's!

10 COOL SHAVES—FREE

BRISTOL-MYERS CO., DEPT. H-101
110 Washington Street,
New York, N. Y.

I'd like to try ten cool Ingram shaves

*Name*_____

*Street*_____

*City*_____ *State*_____

INDEX
Guaranteed Advertisements

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

Biggest news of the year!!

ENCYCLOPAEDIA BRITANNICA
A NEW LOW PRICE

AN unprecedented reduction from the standard price of the Britannica is now publicly announced.

This reduction is possible because long before the regular fall printing went to press, a careful study was made of a plan to meet the conditions of this unusual year boldly and successfully—a plan based upon a faith in the essential soundness of the American economic structure.

After weeks of investigation and thoughtful planning, it was found that the manufacturers could make substantial savings in the cost of paper, binding material, printing and overhead, provided we ordered a printing equal to the largest single printing ever made by the Britannica

Day and night since early summer, therefore, giant presses have been turning out thousands of volumes and we have now completed a printing equal to the biggest single impression of the new Britannica ever made.

The resulting economies are passed on to you. You pay less because we printed more

We believe that many thousands of keen, progressive and prudent people who have always wanted the Britannica will now buy it.

We believe that this printing—large as it is—will be sold out in a comparatively short time, but we frankly don't know whether business conditions will ever make it possible to duplicate this unusually low price again. *You can't afford to delay.*

Send at once for particulars. Now is the time to get full details about the new low prices.

Tear out the corner blank below and you will receive by return mail a large, beautiful, 56-page booklet, rich with color plates, maps and sample pages. It contains a full description of the Britannica and how you can make it your most useful possession. *Send the coupon for the large booklet today*

$5 down and only $5 a month

Our Thrift Plan of purchase favors the pocketbook. Only $5 down is required to bring the set to your home for immediate use. The balance is payable in a few monthly installments of $5 or more, as you wish.

Chief Justice Hughes—
Comprehensive and authoritative. Nothing has been left undone to make it thorough and complete.

General Harbord—
No modern American home can afford to be without this valuable reference work.

Emily Newell Blair—
The homemaker needs this new Britannica.

Emil Ludwig—
A pantheon of the living, and a great harbor of modern science and research.

What You Get The 24 large volumes carry 35,000,000 words written by 3,500 authorities and are richly illustrated with 15,000 pictures, many in full color, and with 500 maps—the whole, indexed with 500,000 separate entries.

Send for this free new booklet today!

ENCYCLOPAEDIA BRITANNICA, Inc.
342 Madison Ave. · New York City

Please send me, without obligation, your 56-page illustrated booklet with color plates and maps from the new Britannica, together with low-price offer, etc.

Name _____

Address _____

City _____ *State* _____

(P.S.M.-M

By

COLLINS P. BLISS

Director of Popular Science Institute

Getting the FACTS *on the Season's New Radio Sets*

In this inclosed, wire-shielded room, painstaking tests of new radio apparatus are made by Popular Science Institute. The wire shielding keeps out all interference.

THE new sets are here and radio enthusiasts are confused again with the problem of what to buy and whether to buy at all. There are some fine receivers to choose from this season and the cost of these new sets is moderate when compared with the price paid for some of the old sets that are still growling out discord in many homes.

Just how the new sets differ from last year's and what they offer in the way of improved radio reception and convenience is told by Alfred P Lane on page seventy-one of this issue. As indicated in his article, the outstanding new circuit features are the super-heterodyne system of amplification and automatic volume control.

Though both of these circuit features afford, with proper design, many improvements in the performance of radio sets, they may also be the cause of many new ills of a character disturbing to owners of sets of careless design. The present orgy of price-cutting in radio is encouraging slip-shod design and hasty adaptation of incompletely developed sales features.

It therefore behooves the buyer to be more careful than ever, and to take advantage of such reliable advice as he may have at his disposal. In this connection, the Popular Science Institute offers its advisory service based on tests that it conducts at its laboratory at New York University

Recognizing the possible deficiencies of improperly designed receivers of the newer types, the Institute has extended its standard test of radio sets to include many new measurements to ascertain the presence or absence of undesirable characteristics peculiar to improperly designed super-heterodynes and receivers with automatic volume control. The new additional measurements include the quantitative determinations of

1. Background noise
2. Heterodyne hiss
3. Image frequency response.
4. Other undesired responses
5. Radiation that might interfere with other receivers
6. Undue side-band cutting
7. Ease of tuning and the accuracy with which it can be set
8. Limits and sufficiency of automatic volume control action
9. Loss of fidelity due to demodulation.
10. Sufficiency of manual volume control.

Besides checking all the points mentioned above, the tests of the Institute determine, of course, whether a set is sufficiently selective, whether it is sensitive to distance reception, whether it reproduces tones faithfully and whether its power handling ability is what it should be. Good value is another item that is by no means overlooked; in judging whether a set is deserving of the approval of Popular Science Institute, its merits as regards the various operating characteristics and its price are considered.

To make tests of the sort described requires elaborate apparatus. The test arrangement employed by the Institute is that which has been accepted as standard by the radio industry and permits the most accurate type of measurements on radio sets. This year, part of this testing equipment has had to be inclosed in the small wire-shielded room shown in the illustration. A double layer of wire screen keeps out electrical interference that would prevent accurate measurements of the highly sensitive sets now available. Anyone who lives in a steel frame house knows how effective metal is in preventing signals from getting through.

The tests described above provide the Institute with considerable accurate data on the current sets and readers will be supplied with a list of good receivers by applying to Popular Science Institute, 381 Fourth Ave., New York, N Y

INSTITUTE BULLETINS

Heating and Ventilating*
Insulation in Building Construction
List of Approved Tools
List of Approved Radio Sets
List of Approved Oil Burners
Advice on Installing Oil Heat
Refrigeration for the Home*

*Starred bulletins 25 cents

Our Readers Say

Did Too Much Water Ever Expand This World?

Here's a question the answer to which I don't know, and more than that, I don't know anyone who can give me the desired information. What I want to know is this: How much did the earth expand at the time of the flood? Or in other words, how much did it contract after the flood abated and dry land reappeared? I should like to have some one answer this in "Our Readers Say." You have a great magazine. Keep up the good work on aviation.—H.M., La Grange, Ill.

A Kindly Bite That Cuts Us to the Quick

As a subscriber for about six years I wish to state that I am generally satisfied in the extreme with your articles, but in reading in a recent issue in an article on "Do Sharks Really Bite Human Beings?" I came across several curious statements. The author mentions, as one of the dangerous invertebrates of the Florida and Gulf Stream district, the "Spanish Man O'War," by which I suppose that he means the Portuguese Man O'War *Physalia pelagica*, which is not such a bad mistake, but in the next breath he identifies it with the "chambered Nautilus," which is, as every zoologist knows, a cephalopod, and entirely harmless. Of course, the *Physalia* is, as your author says, a real menace to life. One would think, however, that your magazine would like to have its statements in accordance with fact, and not to confuse the already small idea of zoology the public may have.—H.V.G., Woods Hole, Mass.

Just a Couple of Earnest Little Suggestions

When I receive Popular Science Monthly, I look first at the table of contents to find the general and special atmosphere of the issue. In order to save me trouble in turning to the contents I cut out a thumb space from the cover similar to that found on dictionaries and reference works. Why cannot the publishers do the same for every copy? In the home workshop section of your magazine, measurements are often given as to the size of things to be made. I suggest that you print a measuring rule on the edge of the back of each issue. It often happens that one is unable instantly to lay one's hands on a yardstick, but if you printed the measure I suggest we should always have a rule right at hand, which you see would be a great accommodation to your readers and would not seriously inconvenience you.—J.B.D., Daly City, Calif.

Here's Another Cry for More Power and Speed

While reading a recent issue of Popular Science Monthly the writer noticed in the "reader's" columns, on page ten, the letter written by P. H. L. of Loveland, Ohio. Having an understung high speed Model "T" himself he believes with P. H. L. that there should be more space devoted to articles on all types of racing cars. Of course the "hints for car machinists" and the helpful talks by Gus are of the very best, yet the writer feels sure that those who have taken up the hobby of building their own cars (and there must be a great number) would like descriptions of novelties in the way of power and speed.—C.M., Lakewood, Ohio.

Dutch West Indian Not Interested in Man's Past

I am a reader of Popular Science Monthly and I like the magazine very much. But I think it would be a fine thing if you would print more articles on what the human race will be in the future and less about what it may have been. I believe that if our scientists spent as much time trying to work out ways and means of making things easier for the human race and devise a way for each person who wants to work and make a comfortable living to get the work that is so necessary for our happiness and well-being, as they do trying to prove to all those who have been taught according to the teachings of the Bible that those teachings which the constitution of the best country of the civilized world today is based upon are false and that the human race in all its power was not created by a Supreme Being, but that it is the result of a fish or some other low thing, they would make this a better world to live in. Anyway, what difference does it make what we have been? It is what we will be that we should be interested in. But I suppose that the scientists are like the rest of us, always trying to make someone out a liar.—G.B.B., Aruba, D. W. I.

One More Point Where Plane and Auto Meet

In a recent issue of Popular Science Monthly I came across an article on aerial and highway traffic conflicting. You stated that the Grand Central Airport in Glendale, Calif., was believed to be the only place in the country where such a condition existed. If it would be of interest to your magazine I would like to state that in Washington, D. C., at the south end of the Highway Bridge, motor traffic has to be halted to allow the passage of aircraft from Hoover Field to Washington Airport which is just across the highway. This condition has just recently come about due to the merging of two corporations that sponsor the field.—E.S., Washington, D. C.

Both the Bartender and the Booze Have a Kick

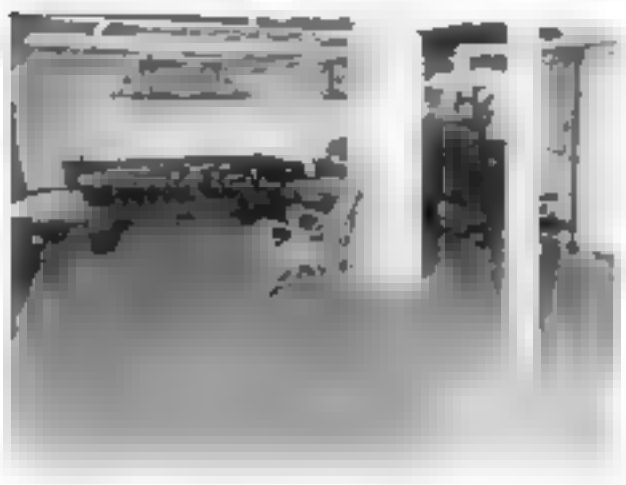
In reply to F.C., O'Leary, Can., who had a thirst-creating problem in a recent issue of Popular Science Monthly, I submit the following solution. If a man mixed a gallon of rum with a half gallon of water, then when the speakeasy man took back his gallon of rum, the man had a half gallon of rum and water, one-third water and two-thirds rum. If he repeated the trick two times more, the final resulting mixture would be one twenty-seventh water and twenty-six-twenty-sevenths rum, or 96.3 percent rum. Which he ought to get some kick out of, what?—R.H.M., Mechanicsville, Iowa.

More Science, Less Flying and Lots of Photography

Why not devote a section of your magazine to photography? It seems as though all you have is aviation. Why not get a little more science in and a little more variety?—R.H., Laramie, Wyoming.

Master Mariner Tells What's What in Boats

Being an ex-sailor and master mariner, I am naturally most interested in boats. In the August issue of Popular Science Monthly is an article headed "Motorboats Race but Stand Still." This makes good reading but I am wondering what such experiments will prove except to show which combination of hull, motor, and propeller makes the best tugboat, but not necessarily the fastest boat. Brute strength alone makes more danger than speed. I claim that if it were possible to tow some of the world's fastest speed boats at their own top speed, after first removing the propellers and substituting ballast for the weight of the drivers, neither of the boats would remain afloat and right side up. Much greater speeds may some day be attained when boat builders adopt an efficient method of streamlining which would eliminate clumsy rear ends without endangering the stability. For instance take a square stern model, lift the keel line starting forward of amidships, and let the deck and keel line meet at the stern



Once the coal bin —now a billiard room

FILLING cracks in the wall, ruts in the floor etc., with Smooth-On No. 7, and painting walls and floor with Smooth-On Iron Concrete Paint, have converted this basement into an attractive room.

Similar treatment of useless cellar space, especially if you have substituted oil or gas heating for coal, would make a play room, billiard den, work or storage room, because the Smooth-On not only produces a handsome easily cleaned finish, but also waterproofs the walls.

Use Smooth-On No. 7 also in making new iron-hard non-dusting waterproof garage and shop floors, filling depressions and cracks in old walls and floors in waterproofing and patching foundations, ponds, troughs, etc. Worked in to the finishing coat during construction, Smooth-On No. 7 makes concrete surfaces lastingly waterproof and more durable, and gives a better appearance.

Use Smooth-On Concrete Paint for ultra-attractive waterproof finish and to stop dusting and crumbling of the old walls and floors.

The cost for the Smooth-On is small and any handyman can do a perfect job. Do this work yourself—you can then afford the improvements and will be well repaid for your efforts.

The Smooth-On Home Booklet sent free on request, gives full directions with quantities required.

Get Smooth-On No. 7 at $ 25 or 100 lb. metal packages and Smooth-On Concrete Paint in gallon pails. There are no substitutes. If your dealer will not supply you, write us direct.

Write for FREE BOOK

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO., Dept. 58.
874 Communipaw Ave., Jersey City, N. J.

Please send the free Smooth-On Repair Book. Quote price on ... lbs. of Smooth-On No. 7.

Name .....

Address .....

10-31 .....

Return this coupon for FREE copy of Booklet

YOU MAY *think* your floors look good enough but that's only because you've become accustomed to their dinginess. If you want to see them as others do merely refinish a small spot under a rug, and compare the old surface with the new. The difference is usually amazing. Only then do you realize how much your home is handicapped by your floors—how much more attractive it could be if only those floors could be improved. They can be. With the Powell you can improve them yourself—easily.

SCRAPE and REFINISH YOUR FLOORS yourself

This amazing little machine does all the heavy work scrapes, sandpapers, refinishes—then keeps your floors in perfect condition forever after—costs but a fraction of one refinishing job.

LOOK at your floors. Are you satisfied with them? Completely satisfied? Proud of them?

You could be. You could make them ten times lovelier. You could make them envied by every neighbor—admired by every visitor. Within a day you could transform them—quickly change them from dingy surfaces, luckily covered up for the most part by rugs, to gleaming, spotless places of which you hate to hide a single inch.

Oh, no!" you say, "Not my floors!" Oh, yes, we answer, *your* floors, ANY floors. The most neglected floors have possibilities. Layer upon layer of old shellac and varnish may disfigure them. Year upon year of ground-in dirt may seemingly defy removal. Yet underneath there is the clean and honest wood—the hidden warmth and color of the grain.

But, the expense?" you say. "I've had them give me estimates. What about the hundreds of dollars refinishing will cost me?" This advertisement offers you a way to overcome that difficulty. It calls your attention to the most remarkable machine ever made for household use a machine that refinishes floors, scrubs floors, polishes floors—a machine that costs but a fraction of what you usually pay for *one* refinishing job. With it you yourself refinish floors with ease. The apparently impossible job of taking off shellac or varnish becomes absurdly easy. The manifestly back-breaking jobs of sandpapering and rubbing in new wax turn out to be a matter of merely guiding a machine.

And this refinishing only needs to be done *once!* The floor never has to be refinished again! Afterward, a little waxing and polishing with the machine once in a while—an operation so simple that a child can master it—*keeps* your floors looking as though they had been refinished the day before.

This is not mere enthusiasm. The claims we make can easily be demonstrated. In twenty-four branch offices we have men ready and anxious to show you, *in your home*, what the Powell Floor Machine can do. In thousands of homes it has already won the unqualified praise of users.

It not only refinishes and polishes wood floors, but scrubs linoleum floors spotlessly clean without the least splashing. It does away with all the drudgery. Gone is the stooping and kneeling, the wear and tear on your hands of water, soap, cleaning fluids, scrubbing brushes and wet rags. Then the machine polishes the linoleum with a result far surpassing anything you have ever known, a shiny immaculate surface that dust and dirt have a hard time sticking to.

Just what the Powell Floor Machine does and how it does it, is a fascinating story that every home-owner should read. We offer you an interesting booklet that contains it—a clear, brightly told description interlarded with explanatory pictures. With your eyes on your floors, can you say, "No, I am not interested"? Ask us for a FREE demonstration—or, if you are too far from our nearest office, a ten-day FREE trial.

For Your Business, Too,

Thousands of leading firms keep their floors spic and span with the Powell. Far cheaper than hand labor. Write for information. See coupon below.

Powell Floor Machine Co.,
720-30 West 19th Street
Dept. PS 1031, New York City

Please mail me information regarding your Electric Machine. I am interested in (Residence) floors.
(Business)

Name .....

Address .....

City ..... State .....

PS-1

in a streamlined fashion, round in the sides aft and round up rear ends of chines. The result would be a sort of streamlined stern. —A.E.H., Brooklyn, N. Y.

India Up in the Air on Two Problems

I AM a reader of your splendid magazine, which affords me interest as well as enlightenment. I should like to have two questions answered that have puzzled my friends and myself. The solution of these problems would be greatly appreciated. The first question is: Our earth revolves around itself once in twenty-four hours. If we go up in the air in an airship and come down after remaining motionless for twelve hours, can we come down on the other side of the earth?

The second question is: There are two men on top of an airship, one at one end and the other at the opposite end. The man at the rear shoots with a gun at the man in front. The speed of the airship is 300 miles an hour, and the speed of the bullet when it leaves the gun is 300 miles an hour. The airship and the bullet are going in the same direction. Will the bullet hit the front man?—V.R.K., Satara, India.

Ignoring Russia Looks Like Quite Some Job

I HAD to laugh when I read F. P. S.'s outburst against the articles on Russia. Russia comprises almost one-sixth of the world's land area, so is it, after all, an easy matter completely to ignore her as F. P. S. advises? I believe that the day is not very far distant when Russia will be the leading industrial nation of Europe. If her exports of wheat and lumber now cause hysterics in this country, as well as many other countries, what will it be a few years from now?—C.O.M., San Pedro, Cal.

That Pulling Magnet Seems to Have Its Own Troubles

B. McC.'s question about the increased weight of the magnet is a fine one. Since the word weight may be defined as the pull of gravity on a body or the force acting upon a body, the magnet would increase its weight because it is pulling towards a fixed body. This extra force acting with gravity would make the magnet weigh more. The magnet is also supporting the needle as well as trying to move towards it so that the needle really becomes a fixed body.—L.W.B., Bloomsburg, Pa.

Wanted: A Good Idea for a Vacuum Blimp

WHY can't some of your smart readers get together and design a vacuum blimp? I suggest that they fill a light shell covering with very light spheres or cylinders to stand the outside atmospheric pressure and pump the air out of the small cylinders, thus making a near vacuum that would be lighter than hydrogen or any other gas. To make it more buoyant, pump out more air, to make it heavier, let in air. Come on now; let's hear who says it can or can't be done.—H.L.C., Canton, Pa.

This Little Growl Comes From Far-off Bombay

I AM one of your subscribers and I find a very bad practice is followed by you in printing in your magazine the advertising matter along with the reading matter. This unnecessarily increases the size of the book at the time of binding together all the numbers and also makes it unsightly. Though it may not be liked by some of the advertisers I think it will be a good policy to separate advertising matter entirely from reading matter.—S.P.N., Bombay, India.

He Knows a Good Thing When He Sees It

I HAVE all of the POPULAR SCIENCE MONTHLY copies I have ever gotten piled away in my case where only those books of special interest are kept.—W.F.H., Maumee, Ohio.

How the Meteor Landed a Knock-out Punch on a Ford

I AM wondering where L. St. J. H., of Richmond, Calif., got his information that meteors always fall in a perfectly vertical direction? Pictures of the sky during a meteor shower show them falling in all directions. I have a photograph that I took one night last summer, and it shows two meteors shooting through the air at a very acute angle to the earth. The big meteor which fell in Arizona and buried itself leaving a huge crater, did not fall vertically, as borings have shown. The body of the meteor is far to one side of the crater. A number of years ago, out in the mountains of southern California, a meteor fell near me one afternoon just before dusk. I was about a quarter of a mile from where it passed between me and a mountain peak, and it appeared to be at approximately a thirty-degree angle from the horizontal. It seemed to be an immense ball of blue flame. It disappeared behind a ridge three or four miles away and exploded with a terrific report. So I think the old Ford might have got the knock-out punch from most any direction, except perhaps from straight underneath.—E.B.M., Fellows, Calif.

He Wants His Cake All at One Mouthful

I BELIEVE that several improvements might be made in your magazine such as printing your model articles in their entirety in one issue. I don't get any kick out of picking up an issue and finding that something interesting is only partly there. The most interesting thing in the magazine is the discussion of simple technical problems and questions. I am not satisfied yet with the explanations given as to what makes the propeller rotate at the end of a notched stick when the notches are rubbed with another stick. Let's hear some more on that question.—L.E.L., Bloomington, Ind.

Russia Has a Few Remarks Intended for Colorado

IN "OUR READERS SAY" I saw a remark made by F.P.S., of Denver, Colo., which could only be issued from a person who either does not know what science and the rational aim of science are. There is one thing that I am positive of. F.P.S. cannot be an American, for if he were how could he help then but to look with admiration at a nation that had for many centuries wallowed in serfdom suddenly becoming so audacious as to throw off this degrading yoke. I shall conclude by apologizing on behalf of Soviet Union to F.P.S. for being the only country in the world that has no aristocracy or money lenders.—M.S., Nicolaieff, Russia.

You Asked for It, L. R. C., So Here It Is

AFTER reading the letter of L.R.C., Los Angeles, it seems that, in spite of all of the modern schools of thought and so on, all of the narrow minded people are not dead yet. If L. R. C. is afraid of the truth he should go back to the Middle Ages, where exponents of the truth were burned at the stake, and people who dared to think and advance theories simply disappeared after a while. In this day and age of scientific enlightenment and progress, there is no place for fear of the truth, and lack of reason, and I would advise L. R. C. to keep his opinions on the history of man to himself. It would appear that L. R. C. would set himself on a pedestal, and permit us poor fools, who believe the words of "monkey scientists" to gaze on his superior wisdom with awe and reverence. If he knows so much about it, why have we not heard of him before?—A. H. S., Norwich, N. Y.

It's Little Indeed Anyone Can Tell the Moron

IN "OUR READERS SAY" column in a recent issue of POPULAR SCIENCE MONTHLY Professor J.W.M., Trenton, Mo., gives a possible and perhaps practical method—"How to tell a moron on sight." On sight, what shall we tell a moron when the moron invariably does the talking? What can you, on sight, tell a moron? Are we all morons except on one or two high spots?—B.H.J., Pittsburgh, Pa.

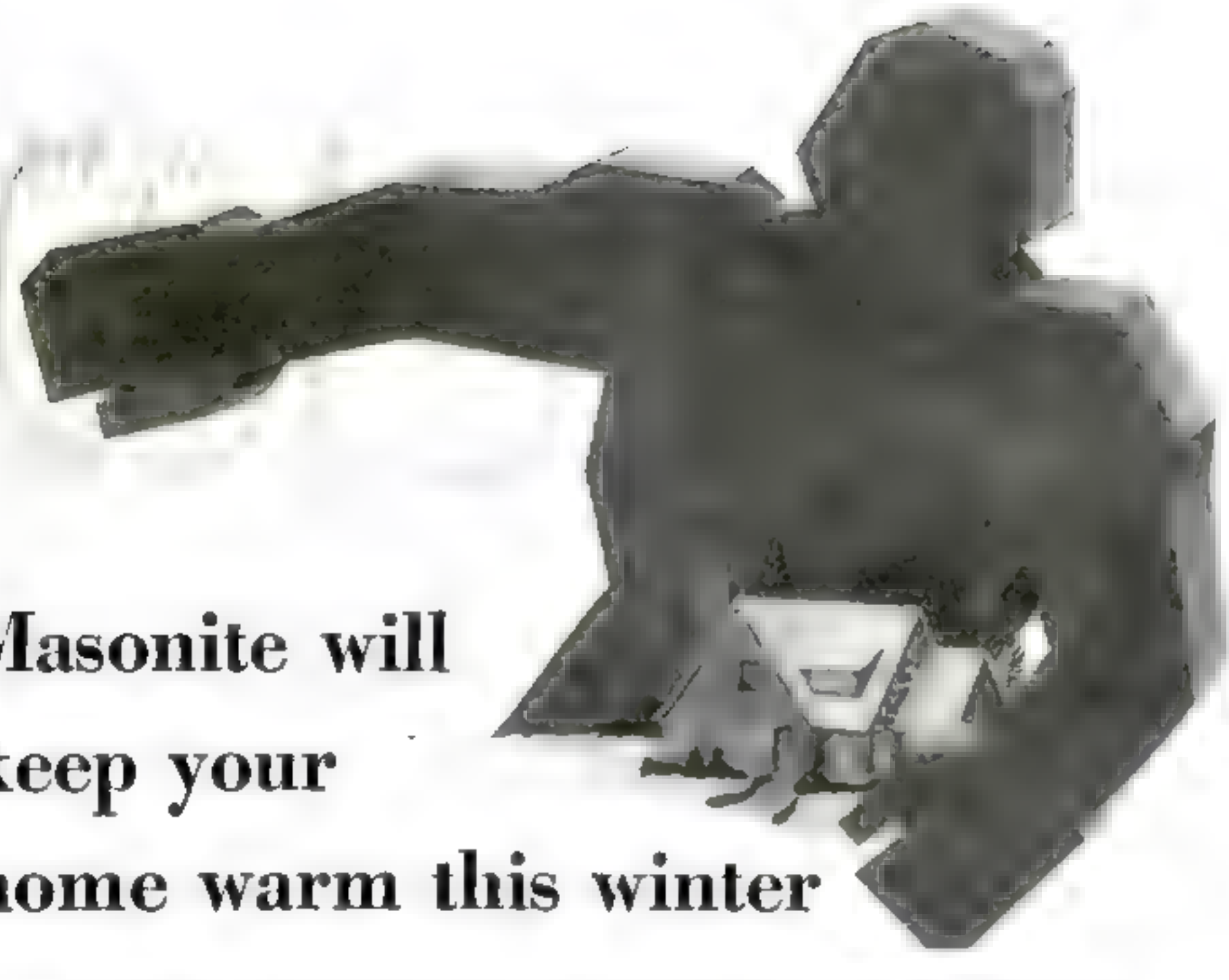
Ambitious Auto Racer Wants Help from You

LET'S have more about auto racing. I certainly agree with P. H. L. on his idea of the type of racing to discuss. How about some articles on the building of better "less costly" racers? There must be hundreds of POPULAR SCIENCE MONTHLY readers who are more than "a little" interested in the racing profession on a small scale. I would appreciate pointers from more experienced hands than myself.—H.E.H., Sioux City, Iowa.

Sharpen Your Pencils on This Trapezoid

HERE is a problem for some of your mathematically inclined readers. There is a plot of ground in the shape of a trapezoid. One base is twelve feet long and the other is six feet long. The two sides are each 140 feet long. Required, to run a fence, from one side to the other, parallel with the bases that will cut the plot into two equal pieces of land. I'm sure it's easy but I find I can't get along without your help.—J.V.M., Altoona, Ala.

Don't fail me



Masonite will keep your home warm this winter

Outdoors, it will be cold this winter—of that you may be sure. But the temperature indoors will depend on whether or not you protect your home with Masonite Structural Insulation.

Masonite does its job well. Keeps heat where it belongs—inside in winter, outside in summer. It's a structural material, too, replaces other materials; converts waste attic and basement space into cheerful, useful rooms.

Build Masonite into walls as sheathing, into roofs and ceilings as insulation, into floors as insulation and sound deadener. That's the practical thing to do—in new building or remodeling. Cuts fuel bills a third or more. Assures continuing value for your property. Enhances the comfort and healthfulness of your home.

For a perfect, crack resistive plaster base, use Masonite Insulating Lath.

We'll gladly send you the free Masonite booklet, telling the story of its manufacture. Or ask your architect, contractor or lumber dealer for information.

Masonite
STRUCTURAL INSULATION
INSULATING LATH • PRESDWOOD • QUARTREBOARD

"Make it out of Presdwood"
—endless uses for this grainless board

Trunks, toys, furniture, truck bodies, incubators, and many, many other articles are better and more economically made with Presdwood. Cuts time and cost in production. Easy to work with—doesn't crack, chip, split, splinter or warp. Home mechanics praise it, too. Check the coupon and send for free Presdwood booklet.

Masonite Corporation, Dept. D-10 © M. C., 1931
[illegible] W. Washington Street, Chicago, Ill.
Please send me [illegible] booklet on Masonite.

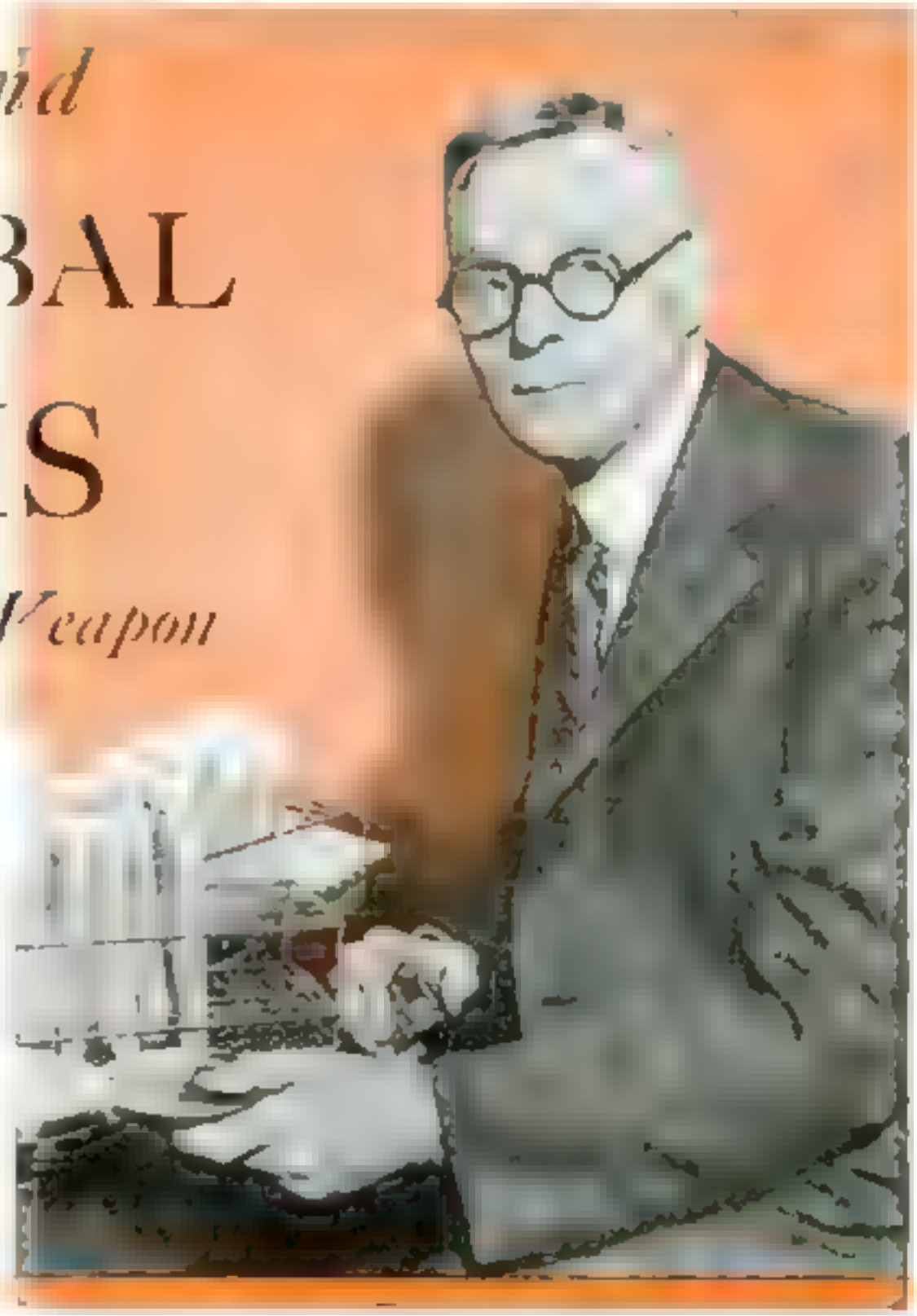
Name
Street
City State
I am interested in Masonite Presdwood, check here

POPULAR SCIENCE
MONTHLY
October 1931 Vol. 119, No. 4
RAYMOND J. BROWN, Editor

New Found CANNIBAL GERMS *in* WAR *on* Disease

Hailed as Mighty Weapon

By CLAYTON R. SLAWTER



DR. ARTHUR I. KENDALL, professor of research bacteriology in the Northwestern University Medical School at Chicago. For the first time in history, he has succeeded in making invisible disease germs visible and has thus been able to see what some of man's worst enemies look like His work indicates that bacteriophage are the invisible form of the germs upon which they feed and now may be produced at will in laboratories.

UNKNOWN to the vast majority of his countrymen, an American scientist, working quietly with test tubes, germ cultures and microscopes in a mid-Western laboratory, has made a series of astounding discoveries that may give the medical profession control over a number of deadly diseases.

He is Dr. Arthur I. Kendall, professor of research bacteriology in the Northwestern University Medical School at Chicago. Made public a few weeks ago, his findings have been hailed the world over as the greatest forward step in medical bacteriology since the days of the immortal Pasteur.

Kendall's discoveries may be said to fall into two closely connected groups. First of all, he has succeeded in growing at will, from the blood of patients suffering from these diseases, the germs that cause influenza, measles, arthritis or inflammation of the joints, common colds, and endocarditis or inflammation of the heart lining. Hitherto all efforts of scientists to identify the germs of these familiar, often fatal maladies, and to grow them in the laboratory, had ended in failure.

This achievement obviously is of the greatest importance to the future study of these diseases and eventually may lead to means of checking them. The reason other scientists were unable to isolate the germs was that the bacteria were invisible, even with the aid of the most powerful microscopes. For the first time in medical history, Kendall has made them visible.

Even more sensational and far-reaching is his discovery, growing out of these experiments, of a method, reminiscent of the magic wishing ring in the fairy tale, by which he arbitrarily can change the germs of many diseases from their invisible to their visible form and back again. This he has done with the germs of influenza, typhoid fever, infantile paralysis, yellow fever pneumonia, scarlet fever, and the bacteria that are responsible for boils, abscesses, blood poisoning, and certain skin diseases.

At right, millions of locusts, each like the one seen below, were destroyed by a sickness that led to the discovery of an invisible agent that kills disease germs without hurting human beings.

At right, a tube of agar cultures. A drop of phage allowed to trickle into the fungus-like growth at top, kills the germs. Above tube at right contains clear broth of animal beef into which bacteria taken from patient are placed. In about eight hours they multiply so culture becomes opaque as seen in center tube. Phage is then added and in a few hours the culture again becomes transparent as seen in left tube, proving that the bacteria have all been destroyed.

The fact that there are two kinds of disease germs, visible and invisible, had been suspected by scientists for some years. The first to suggest this possibility was Dr. F. W. Twort, of London, who, nearly twenty years ago, announced that he believed he had discovered invisible germs. These studies were continued by Dr. F. d'Herelle, a French physician in the Egyptian government service at the time, and now of Yale University, and later led to the theory of the "bacteriophage," which created a sensation in medical circles when it was first announced.

According to this hypothesis, there exist minute, invisible germ parasites, or germ-eating germs (called bacteriophage by Dr. d'Herelle), that prey on disease germs as disease germs prey on us without, however, attacking the human system. Fifteen years ago, at the Pasteur Institute in Paris, d'Herelle for the first time applied his theory, curing a case of dysentery by means of "bacteriophagy."

WHILE it was known that there were visible and invisible germs, it was left for Dr. Philip Hadley, of the University of Michigan, to discover more recently, that there are visible and invisible forms of the same germs. He established this "dual personality" in the case of the germs of dysentery, cholera, typhoid, and diphtheria, which be produced in both visible and invisible form. Outstanding among the results of his researches was the fact that the invisible form of the dysentery germ did not attack rabbits and, more important still, was immune from the bacteriophage.

Now, the tremendous significance of Kendall's contributions lies in these two facts:

First, through his discoveries, the germs change from the visible to the invisible form, and vice-versa, can be watched and controlled. In other words, the tiny, invisible killers now can be brought out into the open, where they may be studied so that methods of combating them may be devised.

Secondly, his work throws a brilliant new light upon the mysterious nature and activities of the bacteriophage. *Kendall actually succeeded in changing these minute, invisible cannibals into the visible germs which they seem to delight in destroying. As foreshadowed in the experiments of Dr. Hadley, it appears, therefore, that bacteriophage simply are the invisible forms of their own prey.*

THOUGH still in their early stages, the possibilities of Kendall's findings to the study of bacteriology and, through it, to medical science, seem limitless. If germ-destroying bacteriophage can be "made" at will, it would seem that ammunition of unprecedented effectiveness could be brought into play in future wars on epidemics. By leading to the creation of such powerful new weapons in the fight on a long list of diseases that have been among the scourges of humanity for centuries, Kendall's discoveries may completely revolutionize the practice of medicine.

When, a few weeks ago, Dr. Kendall concluded the announcement of the outcome of his researches in a lecture before a distinguished scientific gathering at Northwestern University Medical School, the mild-mannered, fifty-four-year-old professor was greeted by an ovation. The moment the applause and cheering ceased, Dr. Edward C. Rosenow, chief of the bacteriology research division of the Mayo Clinic, at Rochester, Minn., said:

"We have just listened to the revelation of a great discovery." Dr. Irving S. Cutter, dean of the faculty of medicine at Northwestern, declared: "This discovery is as startling to the scientific world as were the discoveries of Louis Pasteur sixty years ago."

As in the case of many of the world's great innovations, the secret of Kendall's discovery, once known, is simple enough.

How Sick Locusts Led to the Discovery of a New Cure for Fatal Maladies Is Told in This Dramatic Article

At left in drawing, phage is attacking a group of germs. Next, phage breaks through germ shell, kills germ, which bursts and is consumed.

He found that he could make germs visible or invisible by feeding them on human proteins

Dr Kendall believed that "faulty germ diet" was responsible for the failure of scientists to grow the bacteria of influenza, measles, and small pox all of them invisible, outside of human bodies. The bacteriologists fed them such mild concoctions as beef tea and gelatin, which contain the breakdown, or decomposition, products of proteins. When on the war-path, that is, after penetrating the human or animal body, disease-causing germs, however, thrive on stronger stuff. They eat the pure proteins themselves. As a matter of fact, the human and animal system contains scarcely any breakdown products of proteins.

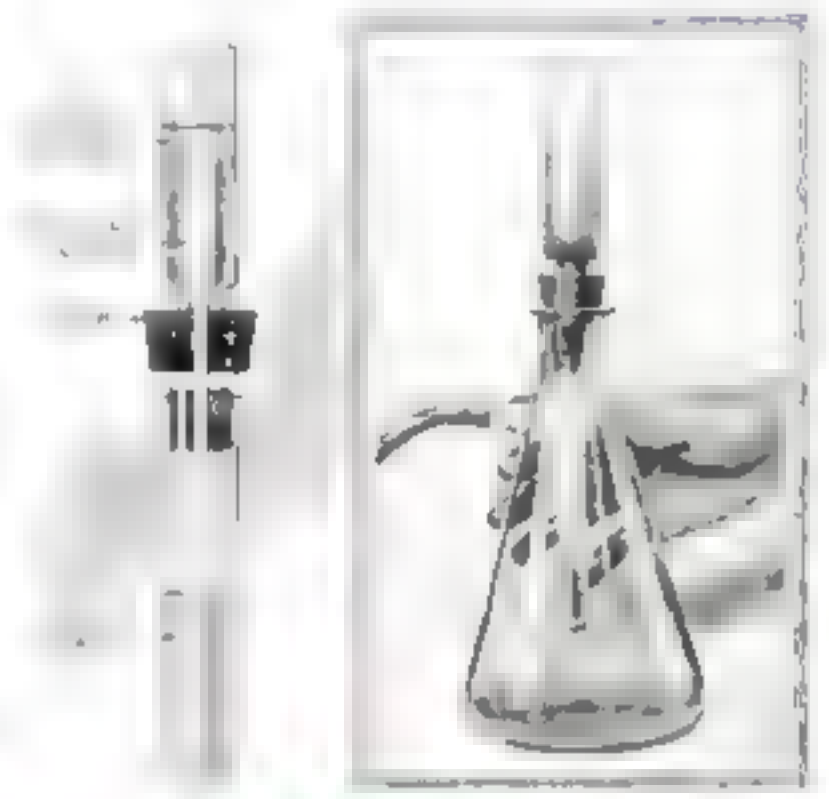
SO KENDALL gave his germs high-protein rations. He made a culture fluid out of pieces of the small intestine of human beings, pigs, dogs or rabbits, which he called "K medium." From this fluid even the faintest traces of breakdown products had been chemically removed. Into the culture he poured blood from human influenza patients, which caused the medium to become cloudy.

To make sure that the new mixture actually contained influenza germs, he injected a few drops of it into the blood-stream of a rabbit. The animal assumed all the well-known symptoms of the "flu." Then came the essential part of the experiment.

He mixed some of his cloudy fluid, consisting it will be remembered, of "K medium" and influenza patients blood, with a quantity of the old-fashioned germ-foods. The result was startling. The germless medium soon was populated by thriving colonies of minute round germs. Here, at last, were influenza germs in their long-sought, visible form!

Kendall repeated this experiment with the hitherto invisible germs of several other diseases, and in each case the result was the same. Then he reversed the procedure. Taking germs that, until then, had been known only in their microscopically visible form when grown in the old fashioned germ-foods he planted them in his high-protein "K medium." They all became invisible. Now he filtered these invisible germs through the very finest of porcelain filters.

The fluid that came through he mixed again with the old-fashioned germ-foods. As though by magic, the germs once more assumed their visible form. No matter how often he repeated the experiments, each time he got visible germs out of invisible virus *(Continued on page 129)*

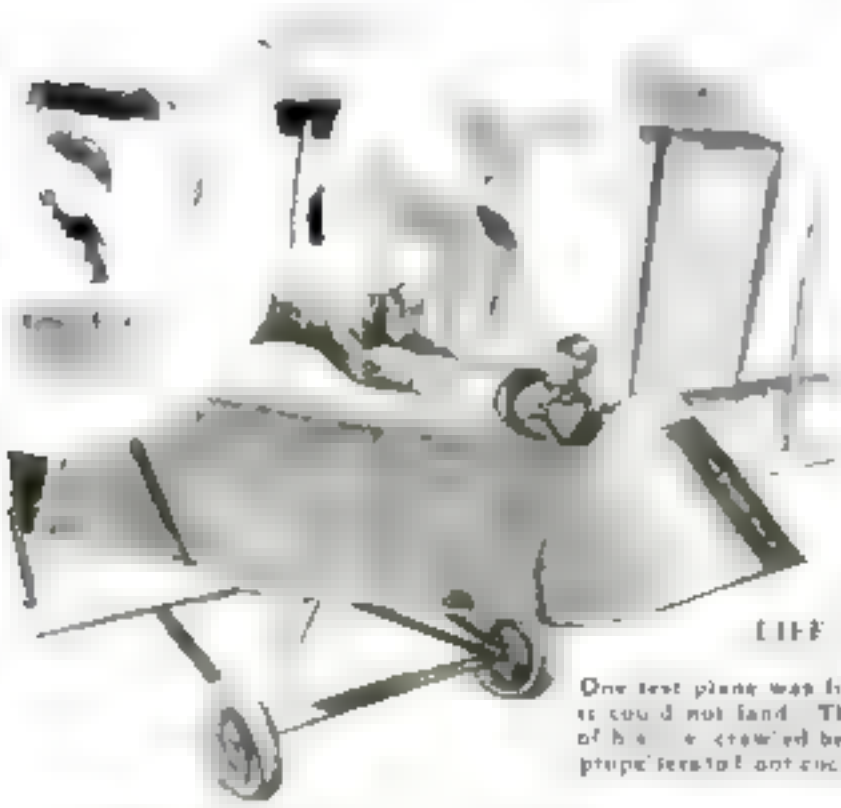


Above, the Berkefeld filter and diagram showing how it works. Through the porcelain candle in bottle's neck the phage is filtered to be sure no germs remain in serum.

Natives of India bathing in the sacred Ganges River which a few miles above this point is polluted with drainage from a densely populated country. However, active phage purify the water before it reaches the crowded bathing beach.

When Courtney first tested autogiros, men pulling on ropes started the windmill vanes whirling. Now the motor does that before take-off

My 10,000 *Flights*



OBSERVER RISKS LIFE TO LAND PLANE

One test plane was found to be so tail heavy it could not land. The observer at the risk of his life crawled between the blades of the propeller into the cockpit to balance machine

With this plywood box bolted to the rudder Courtney tested the big Curtiss "Condor" in order to find the best adjustment for steering the plane. In that way he saved the expense of building a whole series of rudders to find out which was the best

CAPTAIN FRANK T. COURTNEY began flying in England in 1911. During the war, he served as a member of the Royal Flying Corps. In 1919, an accident destroyed his chance of making the first nonstop flight across the Atlantic. In 1928, he attempted to fly the Atlantic from east to west. The engine caught fire in mid-ocean and he drifted for twenty-four hours. He is a famous racing pilot and has tested more new planes than any other flyer.

JUST for fun, the other evening, I jotted down a list of the planes I have ridden into the sky on their initial tests. It totaled more than a hundred different types.

For fifteen years, I have been a free-lance test pilot in England, on the Continent, and in America. During that time I suppose I must have made 10,000 test hops—possibly more than any other pilot in the world.

My most fascinating adventure in test flying began one fall day in London. A relatively unknown Spaniard, Juan de la Cierva, invited me to lunch. He had brought a strange "flying windmill" from Madrid, and asked me to fly it in its early tests. That was in 1925. For eighteen months afterwards, I did all the flying on the five experimental machines that led to the present autogiro. The inside story of those early days has never been told.

One of our early problems was getting the vanes spinning for the take-off. The windmill of the autogiro is not braced like the wings of an airplane. The vanes, free to move up and down, are held rigid during flight by centrifugal force, poling them outward. Aloft, the rushing air keeps the vanes spinning at sufficient speed to maintain this invisible bracing. But on the ground, the vanes must be spun up to 100 revolutions a minute artificially before the take-off can be made. This is now done through a drive from the motor.

IN THE beginning, I had to taxi back and forth across the field to start the windmill going. Then Cierva attached knobs to the underside of the four vanes. Mechanics wound a long rope outside these knobs then ran with the end, spinning the vanes as a boy spins a top. One of the "mechs" who didn't get much fun out of running suggested tying the end of the rope to a stake and taxiing the ship away, spinning the vanes in this manner.

It sounded all right and we tried it. I opened the throttle and the ship moved down the field faster and faster, the vanes streaking around over my head.

By FRANK T. COURTNEY

SMASHED PLANE PREVENTED OCEAN FLIGHT

This plane was built for Courtney's use in a trans-Atlantic flight in 1919. He violated his rule of waiting for a calm day before making a first test flight with the result that he smashed up and lost his opportunity to be the first to fly the Atlantic nonstop. At right, Captain Frank T. Courtney, who tells his experiences in untried planes.

in Untried Planes

They were spinning at more than a hundred revolutions a minute when the end of the rope whistled through the air. There was a loud splintering crash. The ship rocked and trembled. I cut the gun and stopped. The end of the rope, whipping through the air, had sliced through the fin and rudder as cleanly as a knife!

Another accident in those early days taught us an important lesson. The first autogiro I flew had the windmill simply mounted on an old Avro fuselage with the landing wheels comparatively close together.

IN THE early part of 1926, I was giving an exhibit on with this machine at Paris. The sky was ugly when I took off from Villacoublay field. The wind was blowing in gusts. Only the fact that a large assemblage of dignitaries was present made us go on with the demonstration. As I circled the field, the strength of the wind increased. It was a howling forty-mile-an-hour gale when I came down to land.

The ship sat down in the teeth of the wind, not a hundred feet from the cameras. It landed squarely on both wheels. Then a side gust struck the spinning vanes, rocked the ship on its narrow landing gear, heeled it over. The long, flail-like arms thrashed into the mud, flinging it away like sparks from an emery wheel. Then the craft crumpled, lay still. I crawled out, muddy but unhurt.

As a result of that spectacular crack-up, the wide landing gear, giving greater ground stability, was adopted as part of the design of modern autogiros. Another improvement resulted from a hair-raising crash at Southampton, England, a few months later. Two vanes of the rotor fell off in mid-air.

About 150 feet up, I noticed excessive vibration in the vanes. Picking out a long line of trees, I steered directly above them. They would break my fall in the event of a crash. At the end of the line, the vibration was no worse and I swung over the field at 125 feet. Suddenly the vibration increased. The vanes were shaking violently. I started down. At that instant there was a loud crack above my head.

The steel main spar of one of the vanes, crystallized by the vibration, had snapped. The long blade of the windmill broke free, whirled into space. I had one glimpse of it fluttering off like a broken blade of grass. After that, I saw nothing. The uneven jerking of the remaining blades rattled me about in the cockpit like a pea in a tin can. My shoulders were battered black and blue. Fifteen feet up, a second blade tore away from the reeling craft. It fell like a stone.

While I was in the hospital, mending half a dozen broken bones, vertical hinges in addition to horizontal hinges were fitted to the vane spars. This prevents vibration on modern machines and makes impossible a repetition of my accident. Today, the autogiro is less likely to break in the air than an airplane.

BY BRINGING out weak points, revealing needed improvements, and helping adjust and alter new machines, the test pilot plays an important part. Most of the work we do, however, is not with radically new designs like the autogiro. It is with slight variations of well-known types. In the air, the test flyer must note every peculiarity of a new craft. And he must be able to trace the peculiarity to its mechanical source. Of necessity, he must be not only an expert flyer but a trained engineer as well.

I started in aviation in 1913, working without wages at the old Claude Grahame-White factory, *(Continued on page 131)*

Capt. Courtney's FIVE RULES FOR TEST FLYING

1 . . . Weigh the plane to be sure it is in perfect balance before trying to take off. *(See diagram below.)*

2 . . . Sit in the cockpit, switching on and off the ignition and fuel until these emergency movements become instinctive.

3 . . . Make sure the controls are hooked up correctly by "waggling" the stick.

4 . . . Select a large field for the initial tests so there will be plenty of room to maneuver in an emergency.

5 . . . Never take an untried plane up unless the air is calm.

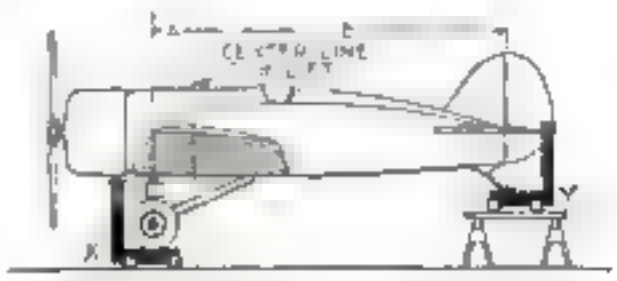
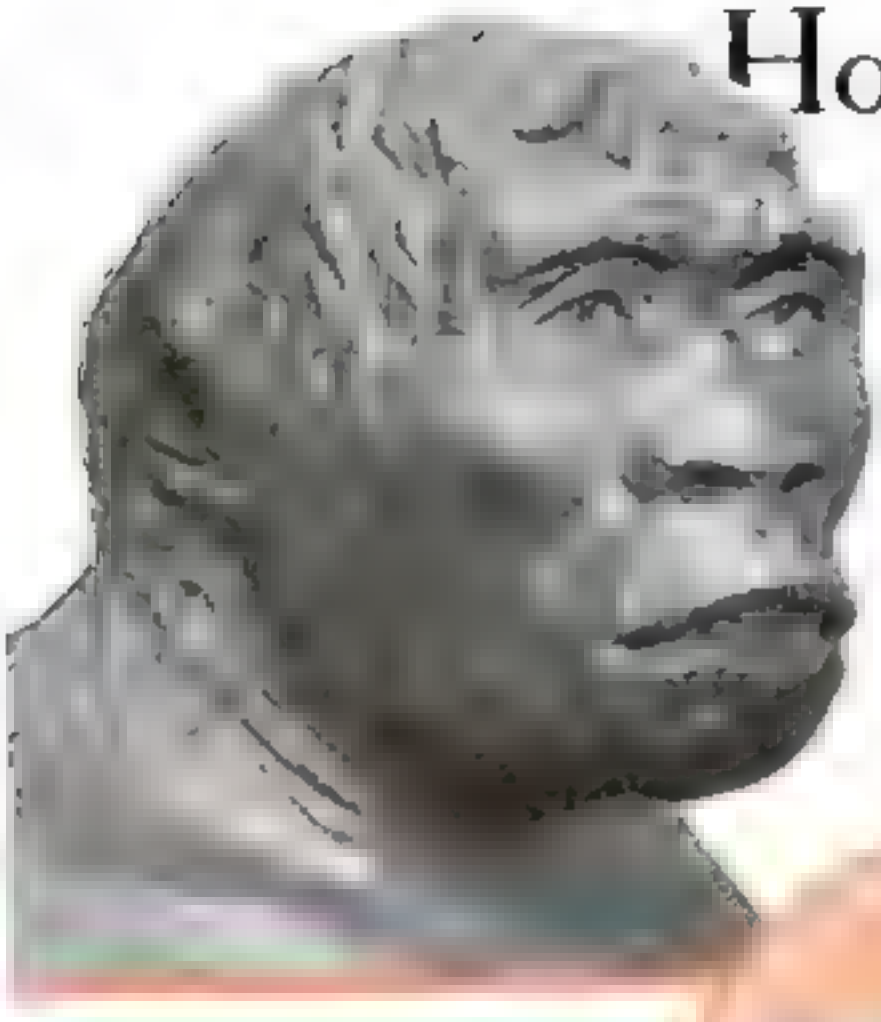


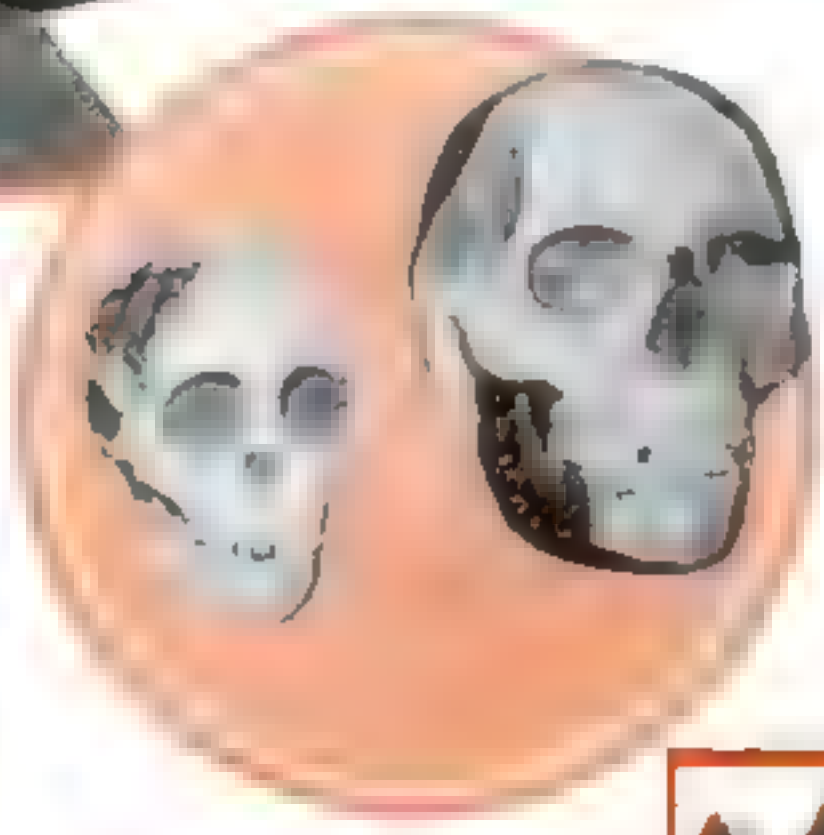
Diagram shows how to weigh an untried plane to see if it is properly balanced. Note scales at front and rear. The formula is: Weight shown by two scales under wheels X times distance A, equals weight shown at Y times distance B if plane is in balance.

How Man-Apes

A Startling Human Chapter



More than 500,000 years ago our ancestors must have resembled this Java Man, *Pithecanthropus*, seen at left. He could talk and had the brain structure of a human being in spite of his apelike appearance. Below, skulls of South African man ape, left, and restored Piltdown man. Note human appearance of teeth in each, which is more obvious in the South African Man-ape



What Has Been Told of Man's History

DR. WILLIAM K. GREGORY famous scientist of the American Museum of Natural History, has explained the origin of the earth and of life; how we got our face and other bodily parts, and man's descent from apelike ancestors. When our earth was about one billion years old, life appeared as little specks of jelly in primeval puddles. Growing into cell-groups, then wormlike creatures, and later into air-breathing fishes that eventually crawled out onto land, these early life germs gave rise to all animals and at last man. Last month, Dr. Gregory traced man's descent from monkey-like forbears that lived in the trees more than ten million years ago, and explained why we are still monkeys.

MR. MOK: Dr. Gregory, you promised to tell me this time about our primitive human ancestors. There are a few things I have always wanted to know. Were they really the lowbrows they are made out to be? Is it true that they were forever clubbing each other over the head?

DR. GREGORY: Yes, clubbing was one of their favorite outdoor sports.

MR. MOK: What made them so vicious? I suppose they inherited that trait from their gorilla grand-uncles?

DR. GREGORY: I don't think so. The manlike apes are models of innocence and without guile, for the simple reason that they haven't brains enough to be wicked.

MR. MOK: You mean it's our brains that make us wicked?

DR. GREGORY: Certainly. We invented wickedness. The earliest men had just enough brains to be devilish. Wickedness and brutality are mostly the products of fear and greed. There is no reason to suppose that primitive people were less fearful and less greedy than our immediate ancestors, not to speak of such contemporaries as the gangster and the racketeer.

MR. MOK: When did we start being good?

DR. GREGORY: About the same time. The brains that enabled early men to misbehave, also led them to discover the principles of social uprightness and service, at least in a groping, primitive way.

MR. MOK: How do you know that?

DR. GREGORY: The Neanderthal men, who lived from 20,000 to 100,000 years ago, buried their dead, showing they had some sense of social obligation. I will tell you more about them after a while. The fact that several types of primitive men made weapons in profusion indicates that they fought alien races and tribes, as well as animals, to protect their own kind, just as we do. Besides, you can infer their probable social conduct from that of the primitive peoples of today, whose lives are full of service and loyalty.

MR. MOK: Then, wickedness on the one hand and a sense of social obligations on the other, marked the first men off from the apes?

DR. GREGORY: Those were among the things that distinguished them from their apelike ancestors. But the great dividing line is speech. That really is man's divine gift. It set him apart from the brutes. However, it is one of the laws of nature that we must pay a penalty for each advance. Speech freed man from the mark of the beast, but it committed him to another form of slavery—conscience.

MR. MOK: Cannot conscience exist apart from speech?

DR. GREGORY: I do not believe it can. Conscience is the accumulated memory of our mothers' scoldings.

MR. MOK: As I understand it, man left the apes behind and became a real man when he began to talk?

DR. GREGORY: Exactly.

MR. MOK: Who was this original orator?

DR. GREGORY: That is difficult to say. As I told you last month, the trouble in this business of the first men is that there are too many "missing links."

MR. MOK: What do you mean by that?

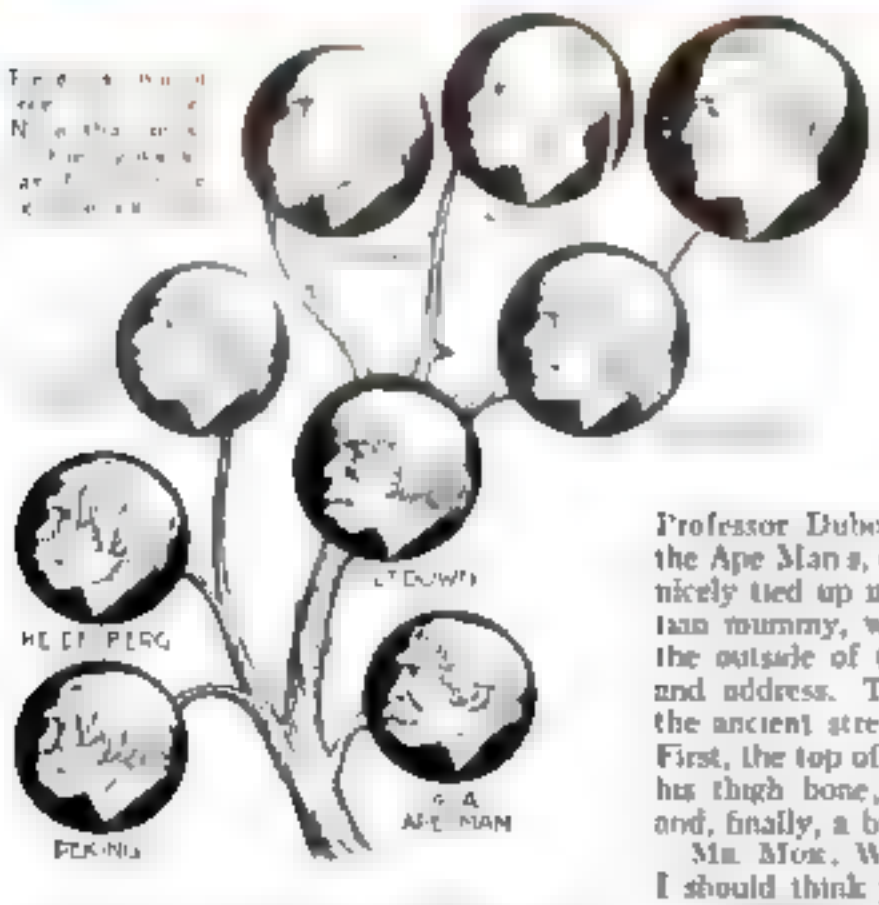
DR. GREGORY: I mean that we now have so many different kinds of fossil men—that is, fossilized remains of pre-human types—that it is hard to determine their relationships to each other and to their ancestors. Paleontologically, there are too many and, at the same time, there are not quite enough

From top to bottom, jaw of a modern man, Piltdown man and orang-utan. A study of these shows how the ape jaw is shortened and slightly lightened in the Piltdown specimen and has been reduced and given a chin in modern man.

became MEN A MILLION YEARS AGO

in the Story of LIFE . . . The World's Greatest Mystery

A [illegible] small anthropoid, [illegible] Museum of Natural History, Chicago. Below, Dr Gregory is [illegible] pointing out the distinctly human features of the skull of [illegible]



of them. In other words, their present number is so large as to be confusing, but not sufficiently large to settle the question. Among these various specimens of skulls, jawbones, teeth, and thighs of his earliest human ancestors, the investigator must pick his way gingerly. Nature is full of booby traps to catch the unwary scientist.

MR. MOX: Booby traps?

DR. GREGORY: Yes. Take, for example, the famous Java Ape Man, or, to give him his official name, *Pithecanthropus Erectus*, discovered in 1891 by a Dutch scientist, Professor Dubois. His remains—I mean the Ape Man's, of course—were not found nicely tied up in a package like an Egyptian mummy, with a gold name plate on the outside of the tomb giving his name and address. They were scattered along the ancient stream bed of the river Solo. First, the top of his head was found, then, his thigh bone, further on, three teeth and, finally, a bit of the chin region.

MR. MOX: What was wrong with that? I should think you scientists would have been delighted!

DR. GREGORY: Not so you could notice it. Immediately, a big, world-wide fight started on this question. Did these fragments belong to one creature and had they been scattered by running water, or were they the remains of several creatures of different kinds?

MR. MOX: What was the answer?

DR. GREGORY: I am coming to that in a minute. Another distressing feature of the situation was that the skull-top was so primitive that many experts did not believe it was human at all. Some said it simply was the toppiece of a giant gibbon. As a matter of fact it was extremely gibbonlike, for it indicated that its owner had jutting eyebrows, a low brain-case, and an excessively low forehead. So, at first, poor *Pithecanthropus* was banned from the sacred precincts of the human family.

MR. MOX: When was he readmitted?

DR. GREGORY: Don't make me run ahead of my story. One circumstance that caused much doubt as to whether we were dealing with one or more creatures was the puzzling combination of his characteristics. The skull-top was extremely apelike. On the other hand, the thigh bone was entirely human. But the most baffling feature was the teeth. Two of the three were molars, and these presented a fine confusion of mixed resemblances. In some ways, they were like the molars of the orang-utan, and in others like those of

Neanderthal head as seen in profile to show relation of restored flesh to skull

living primitive humans, such as the Australian bushmen

MR. MOK: How will we laymen ever find out whether this creature was an ape or a man when you experts can't make up your minds?

DR. GREGORY: Our minds happen to be made up as far as *Pithecanthropus* is concerned. But the fact that experts can scarcely distinguish between the apelike and manlike features of fossils of this kind is due to the close relationship of ape and man. If it were not so close there would be little difficulty. That is what I meant when I said that nature is full of booby traps. As for the Java Ape Man, the poor lowbrow for many years was the defenseless butt for the attacks of those who refused to believe that he was a man. However, after a 'Thirty-Years' War, the matter was finally settled.

MR. MOK: How?

DR. GREGORY: In 1921, Professor Dubois, the Ape Man's discoverer, came forward with a plaster cast of the inside of the skull. It gave a very close approximation of the shape of the brain and showed to the complete satisfaction of the foremost brain experts that *Pithecanthropus* doubtless had been one of humanity's great pioneers.

MR. MOK: What caused the thirty-year delay?

DR. GREGORY: It actually took Dubois that long to remove the rock that during thousands of centuries had accumulated inside the skull. He had to pick it out literally a needleful at a time. When he finally got it free, there was the imprint of the brain inside the skull, as it always is, and all he had to do then was to pour plaster of Paris into it.

MR. MOK: Why did this brain cast remove the doubts as to the Ape Man's status?

DR. GREGORY: Because there is no living ape that can be compared with *Pithecanthropus* in the development of certain parts of the brain.

MR. MOK: Does that mean that he could speak?

DR. GREGORY: Yes, it is the strongest possible evidence that he could.

MR. MOK: What prevents you, then, from assuming that he was the missing link and the world's first possessor of the gift of gab?

DR. GREGORY: I am afraid your early training is responsible for your insistence that one definite individual must have been the first human being. You see there are several of these fossil men of approximately the same age, one about as primitive as the other. Each one is a link in the chain that connects man with his apelike ancestors.

MR. MOK: When did these old chaps walk the earth?

DR. GREGORY: There are various opinions as to their age. My view is that they lived about the beginning of the Great Ice Age—that is, in the neighborhood of 1,000,000 years ago. However, if by "missing link" you mean a specimen that seems to bridge the gap between the highest ape forms and the most primitive humans, then, in my opinion, the little South African fossil man-ape comes closest to filling the bill.

MR. MOK: A man-ape?

DR. GREGORY: Yes. It is the most manlike ape ever discovered. This is the opinion of the majority of scientists who have studied the matter closely, though Dr. Raymond Dart, of South Africa, who discovered this remarkable skull and made his find public in 1925, holds the opposite view. He is convinced we have to do with a direct ancestor of man.

MR. MOK: Why do you call it a *little* man-ape? Was it an especially small species?

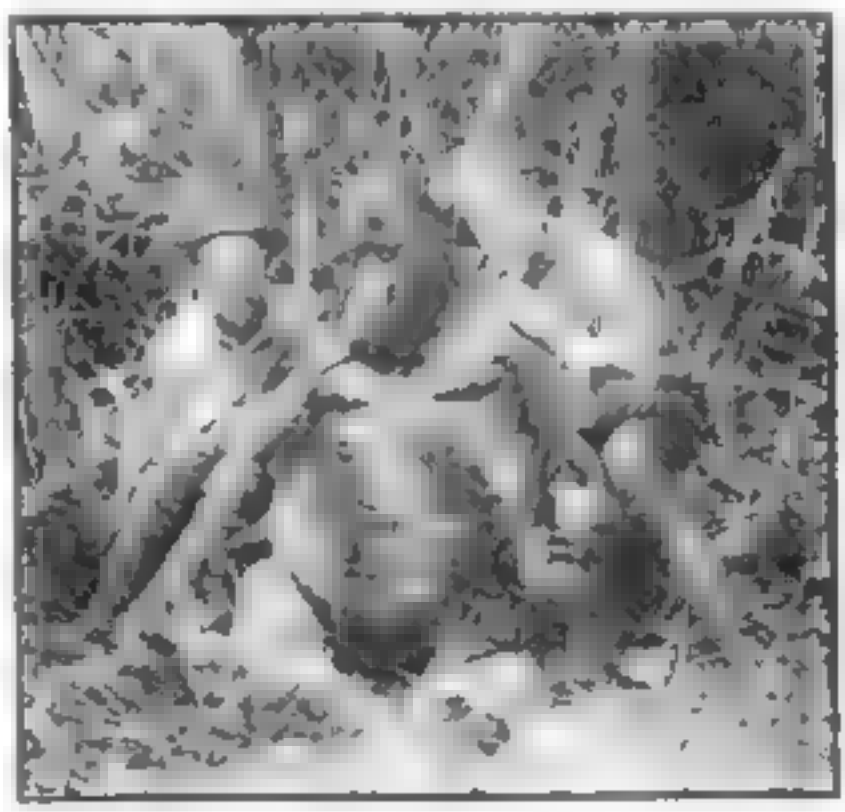
DR. GREGORY: No, it was a young one, probably about three years old. The size of the head is that of a one-year-old human baby but the forehead is less bulging. It is one of the finest and most helpful fossil specimens ever found, for three reasons. First, the bony structure of the face and the brain case both have been preserved. Second, the head exposes the skull on one side and the interior of the brain case on the other. Third, all the milk teeth are in place, as well as the first permanent molars on both sides above and below. Through study of the teeth the approximate age of the creature was established.

MR. MOK: What makes you think that it wasn't just a young ape?

DR. GREGORY: The face is distinctly more like a human infant's than like an ape young's. The shape of the palate also is much more manlike than that of the highest apes, so that the tooth-line is rounded in the human fashion, instead of jutting out. On the other hand, these teeth, when studied individually, show an amazing mixture of human and ape characteristics. And mind you, this time they were not found scattered in a woods or along a stream, but in two neat rows right in the little fellow's head, so there is no doubt that they belong to the one individual. Finally, the brain is slightly but distinctly more advanced than it is in most chimpanzees and gorillas of the same tooth-age, and the brow-ridges do not project as much. Whatever this youngster's exact place on our family tree may be, he shows the first structural steps by which these humble creatures struggled out of the ape stage into the human. But certain features of the place where the skull was found convince me, even more than these structural characteristics, that we are dealing with one of the great intermediate stages between the apes and man.

MR. MOK: Where was it found?

DR. GREGORY: At Taungs, in Bechuanaland, eighty miles north of Kimberley and 1,000 miles (*Continued on page 134*)



Dr. Gregory on the right and R. C. Raven on the left of a dead gorilla killed by Raven last year in the tropic jungles of Africa, one of the only two places in the world where this powerful manlike beast is found. It was through intensive study of this kind made at first hand that Dr. Gregory gathered the facts that he has given you in this remarkable series of original science talks.

Next Month

Why doesn't a Norwegian look like a Chinaman? Why do you look like your mother or your father? Why are some eyes brown and others blue? Why do some couples have only sons and others only daughters? Will it ever be possible to determine the sex of children in advance of birth? In the answers to these questions lie the real secrets of sex. Next month facts on this absorbing subject will be given in language everyone can understand by Dr. Herbert Ruckes, distinguished member of the Biological Faculty of the College of the City of New York, and secretary of the New York Academy of Sciences.

GIANT Movie Sets

Now Built from Tiny Models Are Perfect in Every Detail

Art Director Max Ree with one of the scale models used in the construction of motion picture sets. The models are made with decorations and furniture exactly as these are to appear when set is built.

Below Max Ree is seen looking through the cardboard "camera" designed by him for use in determining camera angles. This cardboard device is adjusted to the motion picture camera's exact aperture and with it the director is able to visualize his shots as they will appear when film is thrown on screen.

In making a picture version of Van Dine's story "The Greene Murder Case" a model set was made following as closely as possible the details as seen in the woodcut shown above, which appeared on the frontispiece of the book. The actual set as it finally appeared is shown at the right. Note the close similarity between woodcut and final set as seen in the two pictures.

MINIATURE scene sets of cardboard, toy actors, and a tiny view finder whose field of vision is exactly proportionate to that of a full-sized movie camera are saving several hundred thousand dollars a year in one of the big talkie studios in Hollywood.

Max Ree, Danish art director, constructs the Lilliputian models complete in every detail and in exact scale to all the settings of a production. Then through the eyepiece of the baby "camera," the director can see exactly how the completed sets will look to the movie camera.

Often the director will go through the action of a whole scene, shifting the tiny wooden actors about the little stage while he peers through the midget "camera" to get the effect.

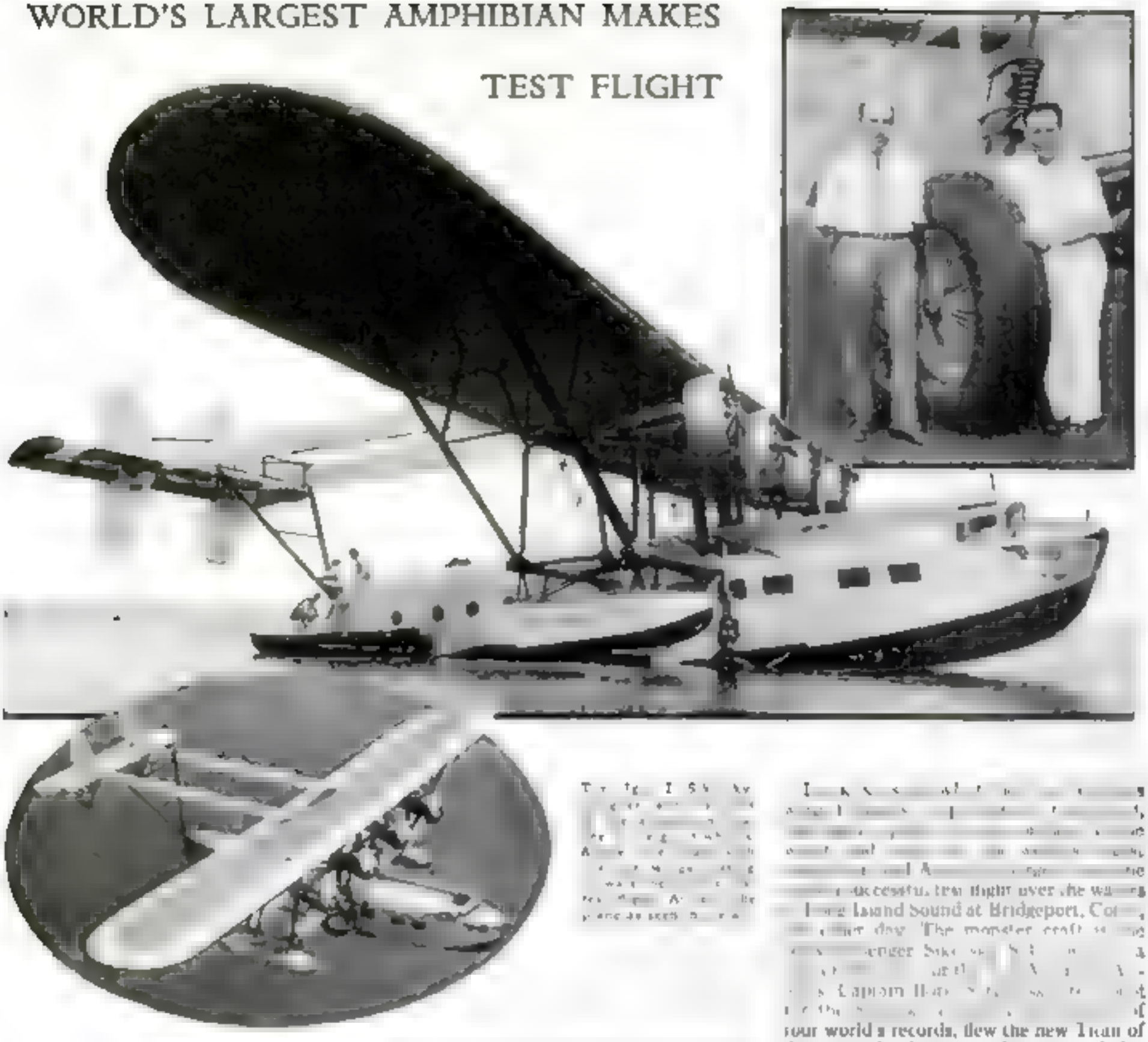
No detail is overlooked. Rugs, paintings, furniture and even the gowns of the actresses are faithfully reproduced. When the tiny set is just as the director wants it, he signs his name on the model and it is sent to the construction department for duplication in full size.

Because the recording of extraneous sounds will spoil a talkie, picture makers now photograph most of their outdoor scenes in the studio where the director can obtain absolute silence. In the complicated and costly sets that reproduce outdoor scenes the use of models for correcting details has proved useful.

According to an estimate by studio officials, these models, by insuring that a set will not be altered or abandoned after it is built, and by eliminating the necessity for costly retakes, are saving from $5,000 to $10,000 on each of the thirty-six pictures that they produce each year.

Set construction for talking pictures is exceedingly expensive, as indicated by the fact that in one Hollywood studio last year, the construction department used more than 2,000,000 feet of lumber, 1,200 kegs of nails, and 11,000 rolls of oatmeal wallpaper in building sets.

WORLD'S LARGEST AMPHIBIAN MAKES TEST FLIGHT



[illegible] successful test flight over the waters of Long Island Sound at Bridgeport, Conn., [illegible] day. The monster craft [illegible] larger Sikorsky [illegible] Captain Boyd [illegible] four world's records, flew the new Titan of the air and, after an eight-minute flight pronounced it to be perfectly balanced and easily handled. Powered by four Pratt and Whitney Hornet motors of 575 horsepower each, and with a wing span of 114 feet, the giant amphibian, when loaded, will weigh 34,000 pounds.

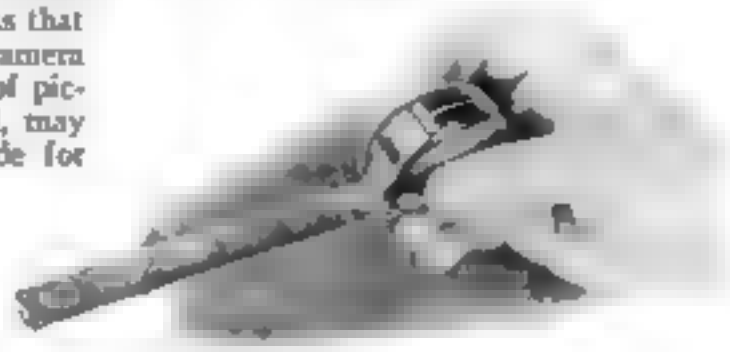
PRISMS GIVE STEREO PHOTOS

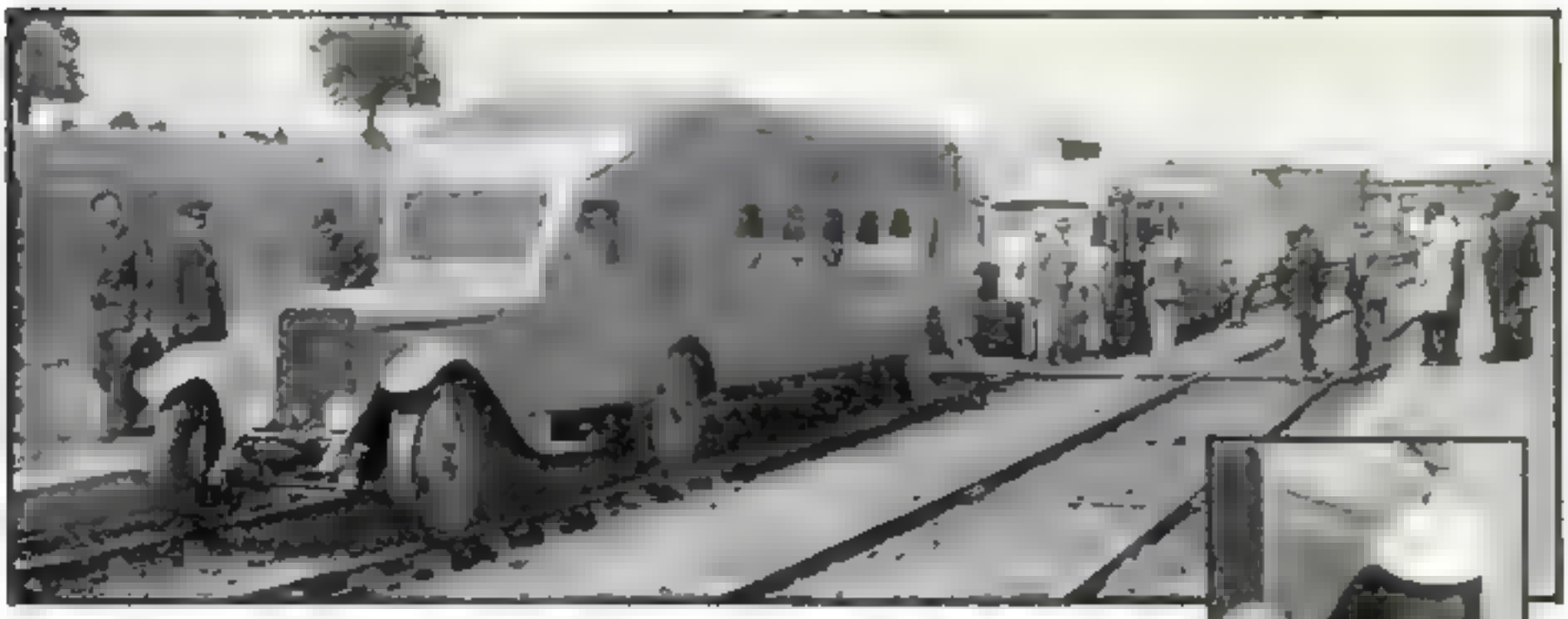
Above, a close-up of the prism attachment. At left, on stand is the special viewing device.

AN ATTACHMENT, recently developed for a popular type of hand camera, which makes small-sized pictures upon a strip of motion picture film, converts it into a stereo camera to take photographs with apparent depth at one exposure. The attachment fits directly over the single standard lens. It contains a pair of prisms that split the scene recorded by the camera into two views. The resulting pair of pictures, when developed and printed, may be viewed in a special holder made for the purpose. Hitherto making a stereoscopic photograph has required either a pair of lenses or a double exposure, with the position of the camera shifted between the two.

SPRING REWINDS NEW SIX-FOOT STEEL TAPE

A SIX-FOOT steel tape that is rigid when desired, yet rolls up on a spring reel at the touch of a push button, is a recent invention. The rule is stiff enough when extended to be projected without support to wall or ceiling, but is sufficiently flexible to be wrapped around a pipe or column

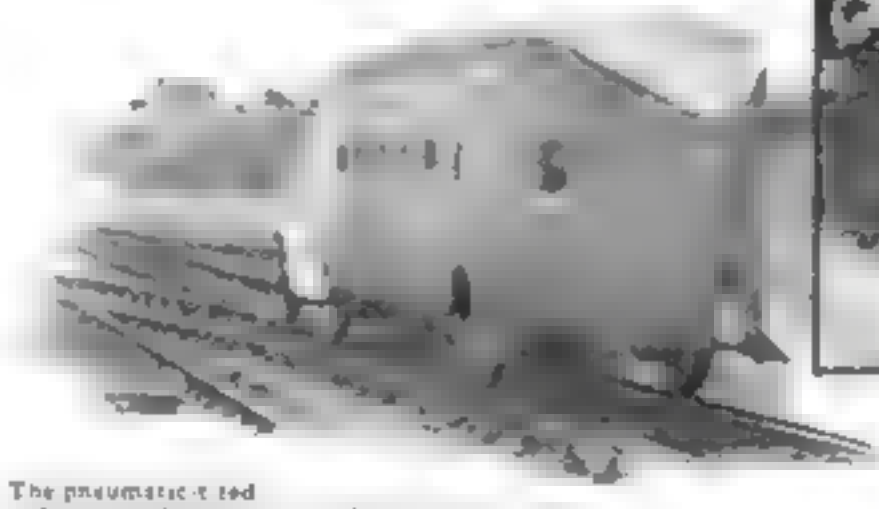




Above, the pneumatic tired rail way car which has recently been tried out near Paris, France

PNEUMATIC TIRED CARS RUN ON RAILS

[illegible] Craig of the [illegible] way vehicles [illegible] test near Paris, France [illegible] houses of [illegible] tried out. One of them [illegible] could easily be heard [illegible] car cars are a dev[illegible] recently described in this magazine (P S M., July '31, p. 60) In the new cars the tires are fitted with wooden cores to prevent them from flattening out in case of a blowout Flanges keep the cars on the tracks



The pneumatic tired railroad car from the rear showing streamlining.

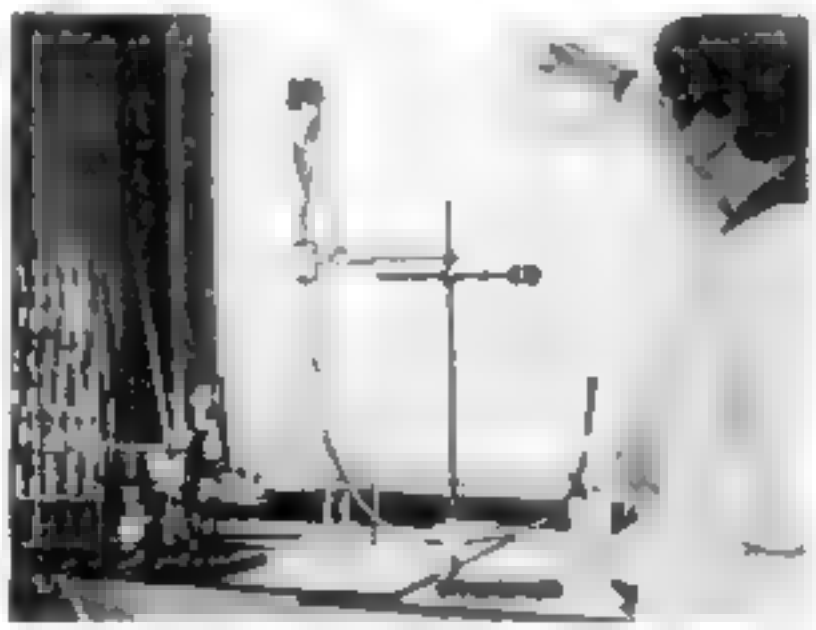
A [illegible] is attached to the coach to rail-way car.

MINISTERS PUT THEIR CHURCH ON WHEELS

When they found the attendance at their churches dwindling seven Baptist ministers of northern Indiana led by the Rev J M Barton, of Hammond, built a "traveling church" upon the chassis of an old automobile. The folding of a bed in its two-foot belfry summons [illegible] as the car parks in a shady [illegible] roof is thrown back, a pu[illegible]

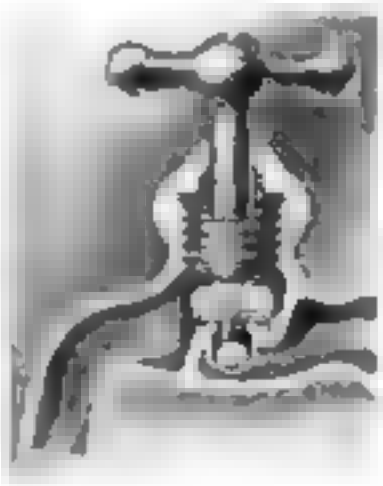
Indiana preachers put their church on auto and toured the state.

PLANT ROBS GERMS OF VIRULENCE



Gro[illegible]

PUTTING typhus germs in a tulip seems an odd experiment yet Dr O. Stickl German bacteriologist, found it led to important discoveries in the changing forms that bacilli can assume. When these ordinarily deadly germs were taken from the inoculated flower, they seemed to have lost all their virulence Tuberculosis germs showed a similar reaction. Fraught with significance as leading to possible curative methods the experiment is interesting to compare with the recent work described on page seventeen of this issue

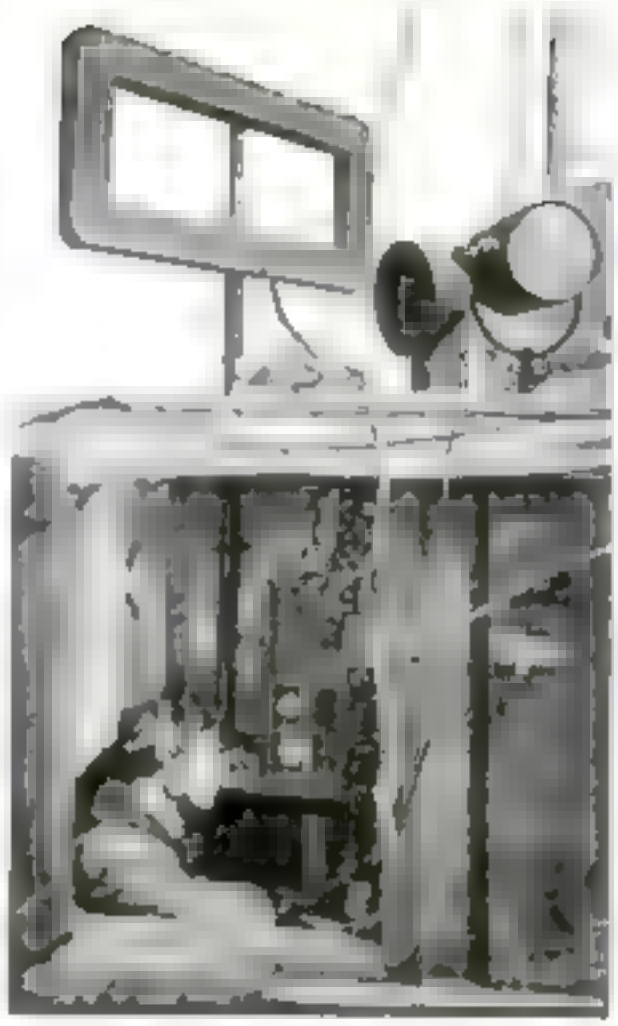


AUTOMATIC SHUT-OFF FOR WATER FAUCET

A new ball valve for water faucets serves as an automatic shut off When the faucet stem is removed, water pressure forces a steel ball against a water-tight seat in the valve housing This prevents any leakage Not only is the device a convenience for home owners, but it is especially valuable in hospitals and railway stations, where shutting off the entire system would be a great inconvenience

LIGHT BEAM CARRIES VOICE HALF MILE

Voices traveled more than half a mile on a beam of light in a recent New York experiment. From a New York pier, John Bellamy Taylor, General Electric Company engineer, thus talked with persons aboard the liner *President Hoover* moored across the Hudson River on the New Jersey shore. The apparatus employed a principle that has been demonstrated before on a small scale, in the laboratory. The speaker's voice was picked up by a microphone and converted into electrical vibrations, which in turn caused a neon lamp to flicker. At the receiving end a light-sensitive "electric eye" and a loudspeaker converted the fluctuating light rays back into speech. Unlike radio broadcasting, there could be no interference between a pair of transmitters, since the lamp's rays are projected by a mirror in a narrow beam and received in another reflector. This method, termed "narrow-casting," therefore suggests interesting possibilities for communication over distances not too great for a searchlight ray to travel, as between ships in a harbor or from ship to shore. The apparatus, shown in the photograph above, is effective even on a bright, sunshiny day and may be used for secret signals. In the test, shipboard observers saw only a small red light on the distant pier, apparently burning steadily. Its flickers were too rapid to be detected by the eye.



LINER'S LIFEBOATS NOW HAVE RADIO OUTFIT

THE big motor-driven lifeboats of the Canadian Pacific liner *Empress of Britain* are now equipped with radio. In the event of a disaster at sea, a rescue ship could thus keep in constant touch with the survivors. Since the hunt for them would therefore be a short one, the occupants would face less peril from long exposure. The radio equipment includes a transmitter with a power of a quarter of a kilowatt, and a direction finder. The radio cabin of one of the lifeboats is shown above.

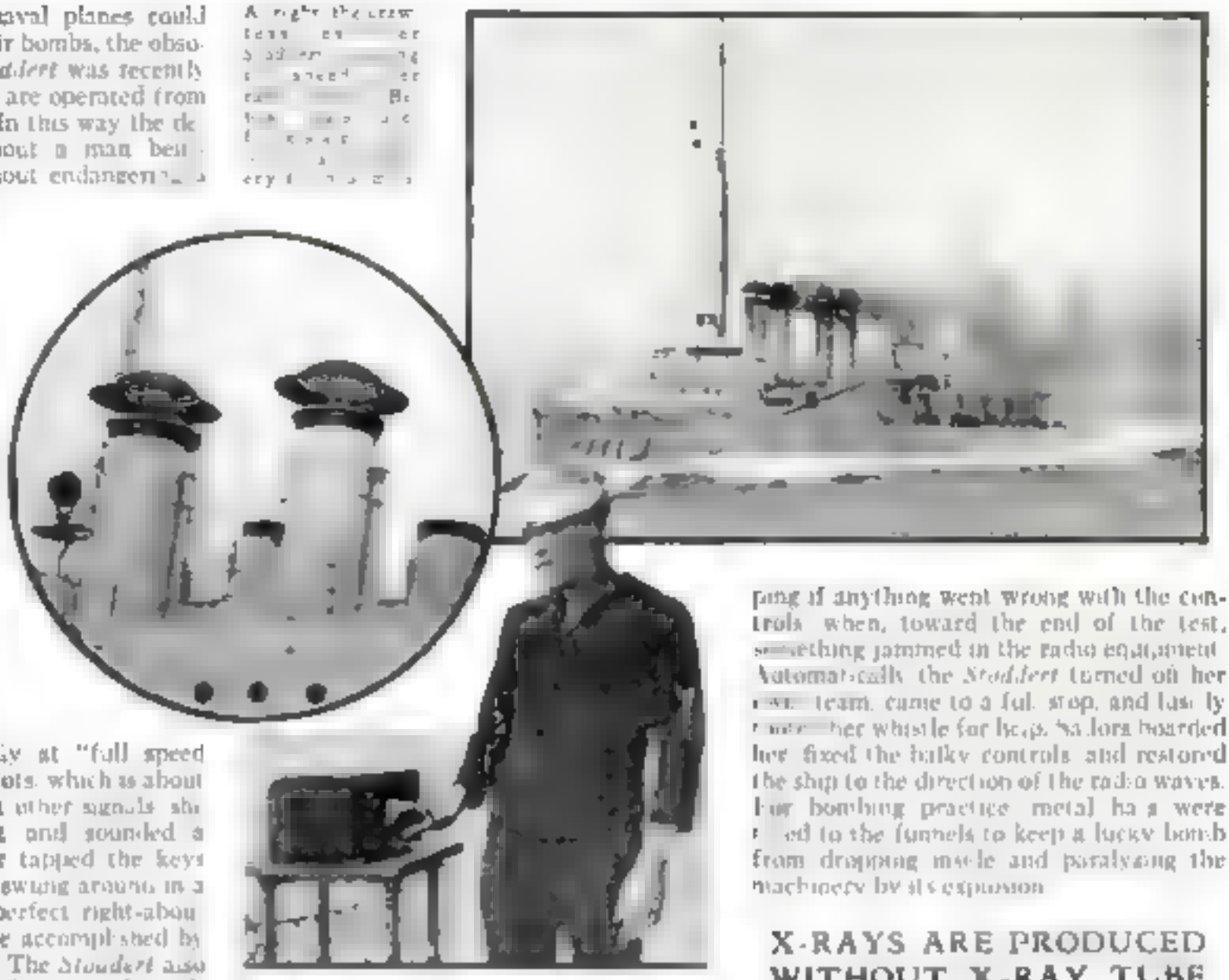
PLANES BOMB AIRPORT WITH CHALK

END TABLE PHONOGRAPH TAKES LITTLE ROOM

A NEW convenience to music lovers, particularly those in small apartments, is an end table phonograph. Normally it resembles an ordinary article of furniture. But the top slides back, without disturbing ornaments or books that may be lying upon it, revealing the turntable. Below is a shelf for record albums. The phonograph has an electric pick-up and is connected to the radio for reproduction of the music.

CREWLESS BOAT, RUN BY RADIO, PERFORMS NEW FEATS

So THAT swooping naval planes could use it as a target for their bombs, the obsolete U. S. destroyer *Stoddert* was recently fitted with controls that are operated from another ship by radio. In this way the destroyer is moved without a man beaboard, and hence without endangering human life. Similar feats have been performed several times in the past, but in tests off San Diego, Calif the *Stoddert* successfully executed maneuvers never before attempted with a crewless ship. On the bridge of the U. S. S. *Perry*, steaming 200 yards behind the old destroyer, a radio officer punched typewriter-like keys on a box-shaped apparatus. In response to these signals, the crewless *Stoddert* picked up speed, first to six knots, then twenty, and finally at "full speed ahead" or twenty-six knots, which is about thirty miles an hour. At other signals she flashed her searchlight and sounded a siren. The radio officer tapped the keys again, and the *Stoddert* swung around in a wide circle to make a perfect right-about turn, a feat never before accomplished by a radio controlled boat. The *Stoddert* also demonstrated a safety device to keep it from running wild and endangering ship-



This radio robot on the bridge of the *Perry* ran the *Stoddert*, performing duties of a human crew.

ping if anything went wrong with the controls when, toward the end of the test, something jammed in the radio equipment. Automatically the *Stoddert* turned on her [illegible] team, came to a full stop, and lastly sounded her whistle for help. Sailors boarded her, fixed the balky controls and restored the ship to the direction of the radio waves. For bombing practice metal hats were fixed to the funnels to keep a lucky bomb from dropping inside and paralyzing the machinery by its explosion.

BALLOONS AIDED ZEPPELIN IN ARCTIC

Above, diagram showing how weather recording balloons automatically reported Arctic [illegible] to guide the big dirigible

MINIATURE balloons aided the *Graf Zeppelin* when it cruised into the Arctic recently on an exploring trip. One type invented by a Russian, automatically broadcast weather reports by radio from high latitudes. A number of these during the voyage were released from a special compartment built into the airship and observed Arctic air conditions [illegible] test one of the eight-foot spheres reached the extraordinary altitude of 50,000 feet and at that height transmitted radio signals. Another type of balloon was carried by the Soviet ice breaker *Malygin*, which met the *Graf Zeppelin* in the Arctic. This balloon, covered with mirrors, caught the sun's rays and made a marker to help the dirigible find the ship. With these aids, the airship was able to accomplish the work of two or three years of exploration in only seventy hours, according to scientists aboard. It mapped an area of nearly 25,000 square miles east and west of Franz Josef Land, in some of the most inaccessible spots on the globe.

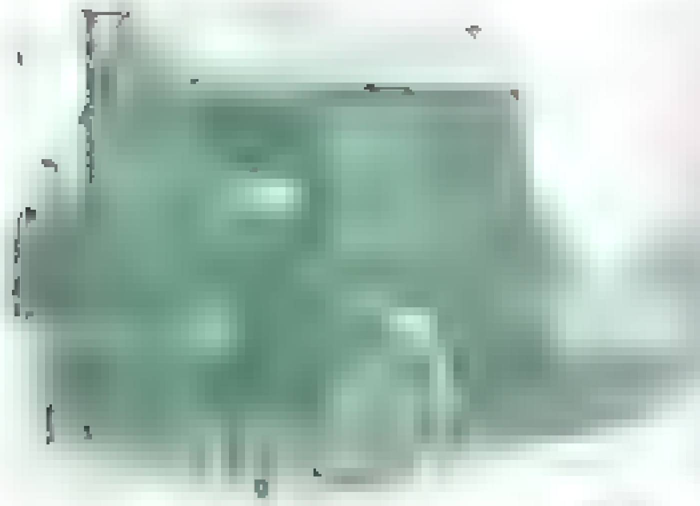
X-RAYS ARE PRODUCED WITHOUT X-RAY TUBE

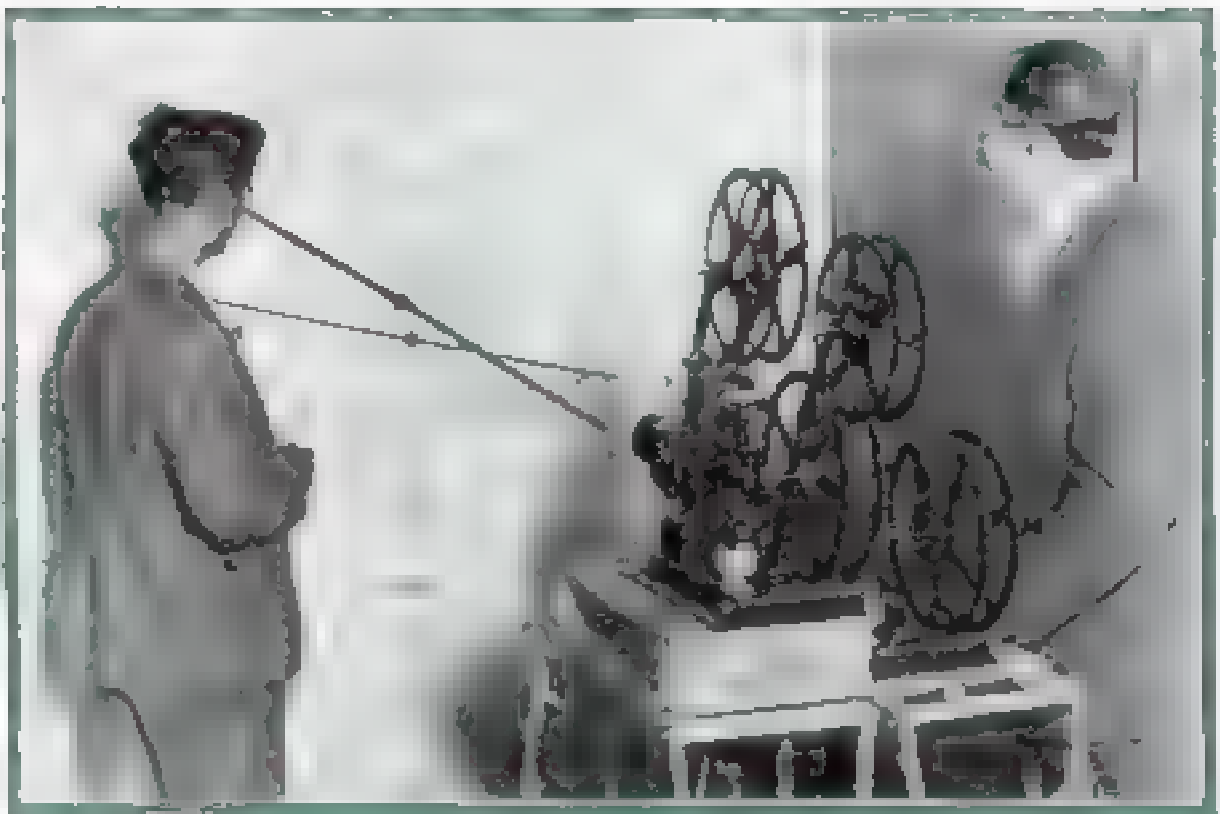
X RAYS have now been produced without an X-ray tube. A French physicist, M. G. Reboul, recently demonstrated that high-voltage electric currents produced X-rays of low penetrating power when they were forced through magnesia, alum, yellow oxide of mercury, and other substances of high electrical resistance. He devised a simple apparatus to generate the rays which may prove more convenient for medical and industrial use than the conventional glass tube, exhausted to a high vacuum.

FLYERS USE HAND TO WARN OF MOVEMENTS

To WARN other pilots of their movements, aviators at a Glendale, Calif., flying field use hand signals. Extending the hand diagonally upward means a right turn straight out, a left turn; downward means the pilot will land. Above a grid student is seen learning the signals.

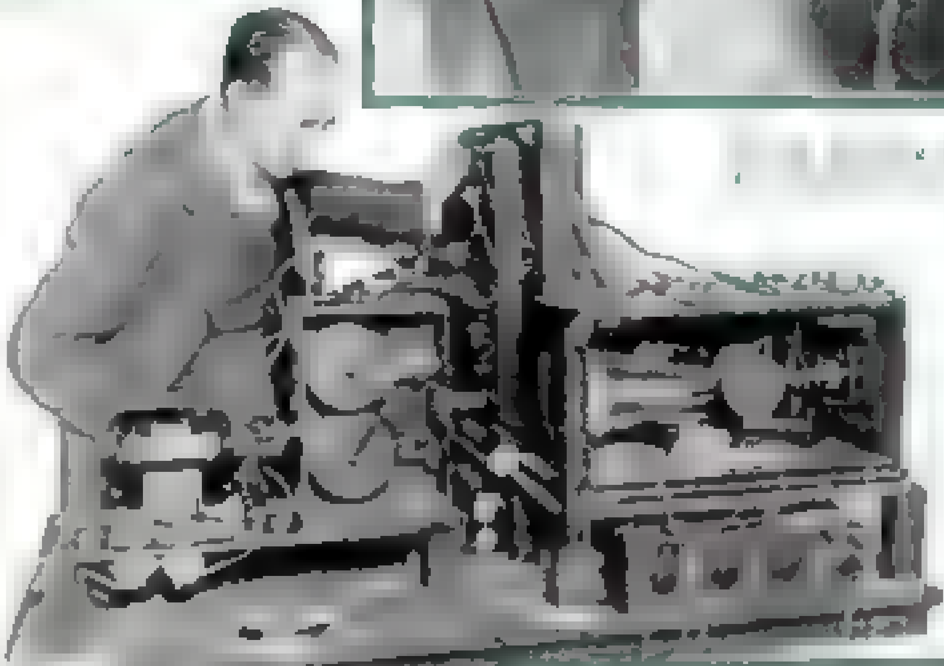
Thunderstorms Tracked *by* RADIO



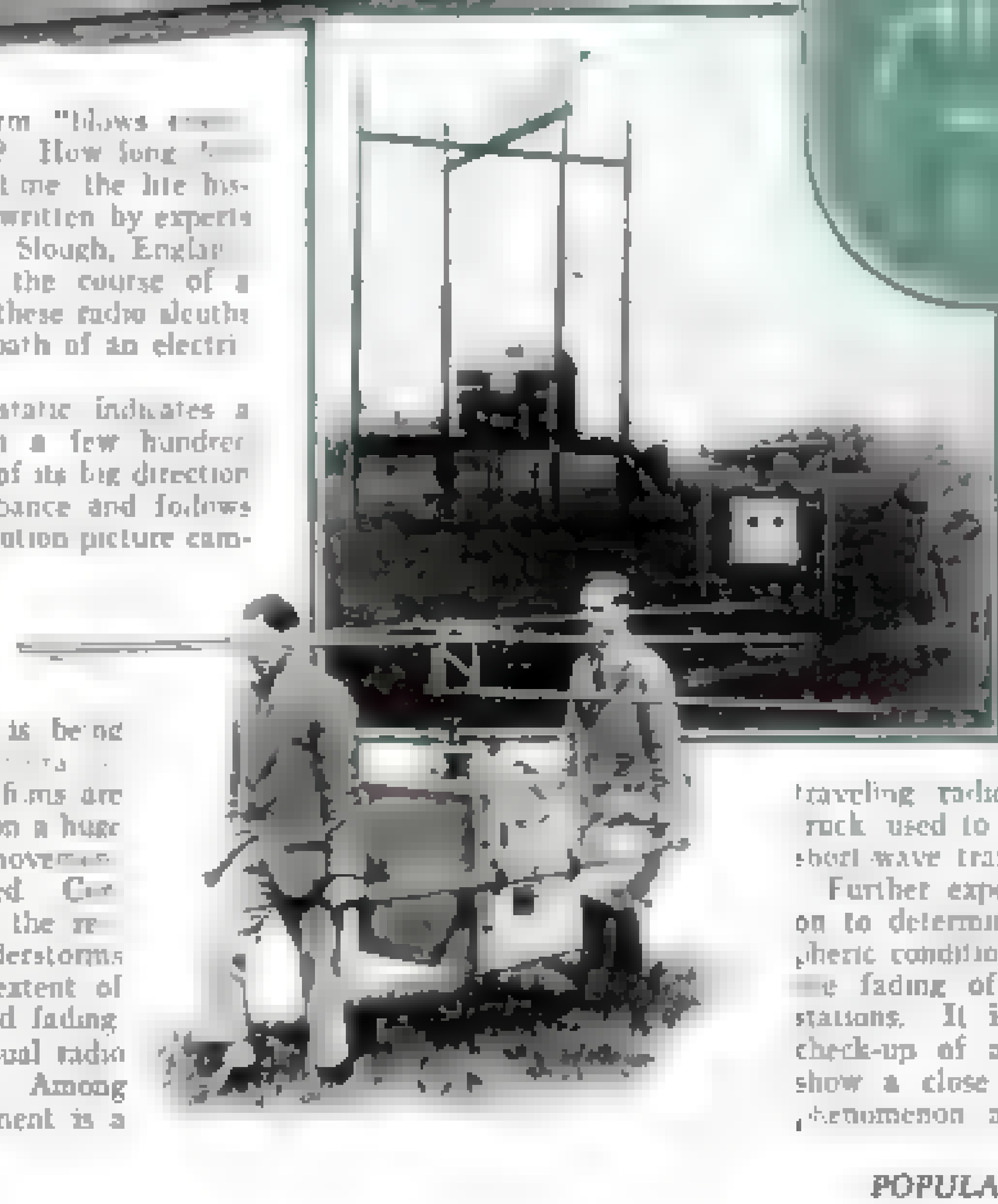


[illegible]

This radio direction finder shown above, [illegible] swinging in any desired direction to find the exact location of a lightning flash. In this way the course of [illegible] can be charted. At right, the cathode ray oscillograph and the movie camera with the [illegible] that is used to drive it



Above is the traveling [illegible] of the research department at Slough, England, and at left the small short-wave direction finder is being tested. In the background is the big direction finder. Lower [illegible] portable direction finder now being used in [illegible] short-wave tests



WHEN a thunderstorm "blows over," where does it go—and how far? How long does it last? Probably for the first time the life history of a thunderstorm is being written by experts of the radio research station at Slough, England. Just as the weatherman plots the course of a cyclonic storm or a tornado, so these radio sleuths have found a way to trace the path of an electric storm across a continent.

As soon as the crackle of static indicates a thunderstorm somewhere within a few hundred miles of the Slough station, one of its big direction finders is trained on the disturbance and follows its movements. An automatic motion picture camera keeps a second-by-second record of the [illegible] through an ingenious hook-up employing a device known as a cathode ray oscillograph.

Meanwhile a similar record is being made on a [illegible] at Leuchars, Scotland. When the films are brought together and projected on a huge map, a complete record of the movements of the storm's center is obtained. Correlated with local observations, the records show the effect of thunderstorms upon radio reception and the extent of their responsibility for static and fading.

A center for research in unusual radio problems is the Slough station. Among its most novel pieces of equipment is a traveling radio laboratory in a motor truck used to investigate the vagaries of short-wave transmission.

Further experiments are being carried on to determine, if possible, the atmospheric conditions that are responsible for the fading of Continental broadcasting stations. It is expected that a careful check-up of all records of fading will show a close relationship between this phenomenon and electrical disturbance.

Mechanical Monster

"EATS" Girl on Movie Stage

Photo above shows the monster in the midst of stage action with one girl on his back and another in his mouth.

Drawing by B. G. Seckinad

A MECHANICAL dinosaur nearly fifty feet long lumbered across the stage of the Roxy Theater in New York recently, seized a ballet girl in its huge jaws and bore her into the wings. On this page the secret of the amazing illusion is explained by our artist. The reptile's painted body of felt and muslin over a rattan framework, was hollow. Two men within controlled the movements. Since it weighed 3,200 pounds, they could not have moved it by their own strength. Therefore they manipulated the controls of electric motors, which operated the limbs. Guided by its "motormen," the dinosaur moved about on rubber-tired, ball-bearing castors. An ingenious eccentric movement connected to them caused the shoulders on each side to rise and fall alternately, giving the creature a rolling gait. In the monster's sensational exit that climaxed the performance, the girl in its jaws suffered no injury. Engineers of the firm of Messmore and Damon, which built the creature, devised a set of powerful jaws which would pick her up without hurting her by lining the teeth, lips and tongue with sponge rubber. In this manner a convincing illusion of life was given to the mechanical recreation of a creature that roamed jungles where no man lived.

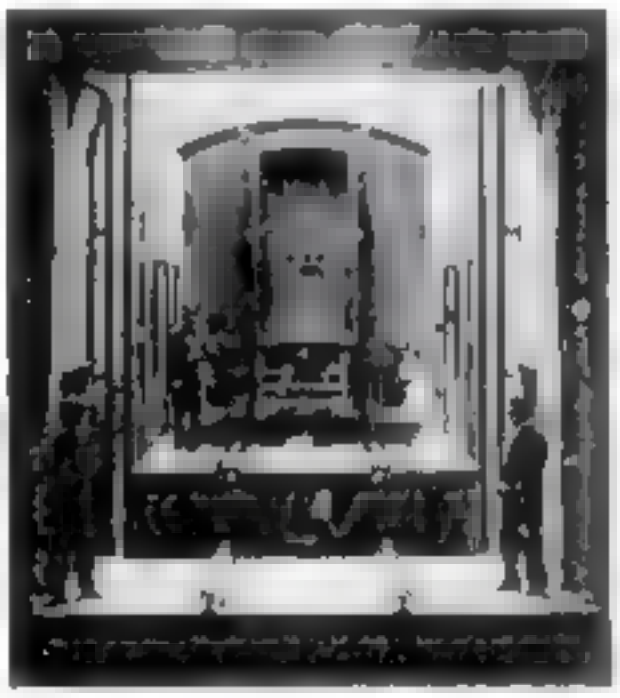
PICK-UP INCREASES PHONOGRAPH TONES

With a novel type of phonograph pick-up, designed to be held in the hand, a music lover can hear bass drums and other low-pitched orchestral sounds on his phonograph records that the average commercial instrument cannot reproduce. The device is intended especially for physicians, however, and is used to listen to recorded heartbeats, through an earpiece adapted from an ordinary stethoscope. It replaces complicated and expensive apparatus formerly used for the same purpose. One phonograph concern has made, for physicians, a dozen or so phonograph records of the most usual type of heart abnormalities which gives the doctor the characteristic sounds.

HEADLIGHT REPAIRMEN PATROL CITY STREETS

If a San Francisco motorist on the road at night sees a white-clad motorcyclist draw alongside and hold up his hand it does not mean that he is to be handed a summons. The motorcyclist is a headlight repair man. Four of them, distinguished from policemen by their unusual costumes, are now patrolling the city's streets looking for cars with one or more lights out. When one of these riders spies a prospective customer, he stops him and offers to replace the defective headlight at a nominal fee. Usually the driver accepts as this is cheaper than continuing and getting a summons.

NEW RUBBER SUIT IS LIFE PRESERVER



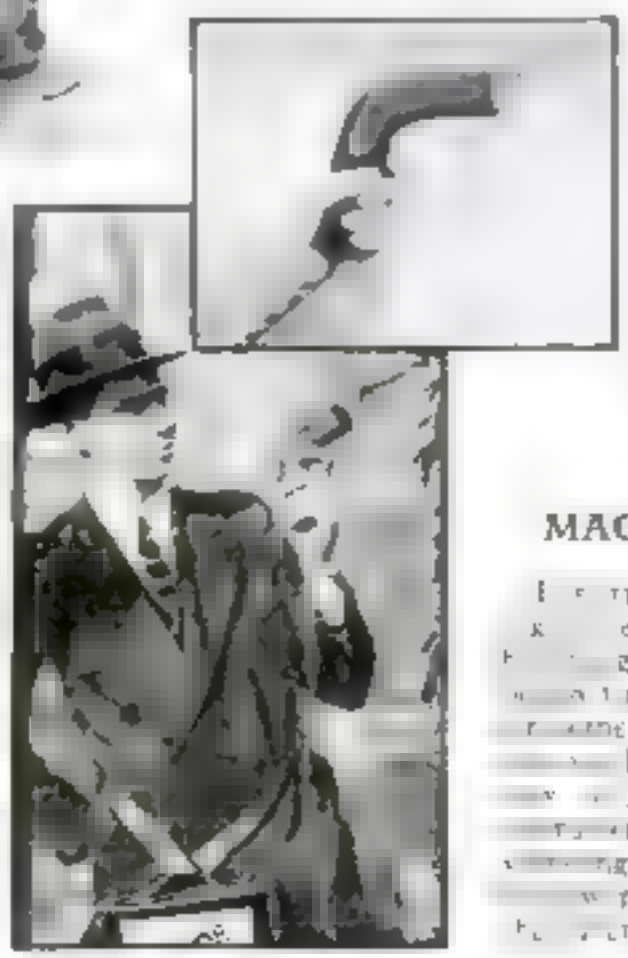
MAIL CAR ON ELEVATOR GOES TO POST OFFICE

An elevator that carries mail cars direct from the railroad tracks to the post office is a novel feature of a huge railway station just opened at Milan, Italy. Postal employees, working on an upper floor of the building, may thus load it with a maximum of convenience. After all the mail is aboard, the car is lowered to the main tracks again and attached to a train. The system saves at least two handlings of the mail.

CHINESE THEATERS PASS HOT TOWELS

When American movies invade foreign lands, they are likely to meet with a strange reception, according to the customs of the country. In the theaters of interior China, an attendant stands at [illegible] side of the auditorium. When he sees an upraised hand in the audience, he wrings out a hot towel and deftly shoots it sometimes as far as fifty feet, to the patron. The recipient wipes off his face and goes on watching the show. Before every kissing sequence in a film, an announcer explains and demonstrates what a kiss is, and what it means to white people. The Chinese do not kiss.

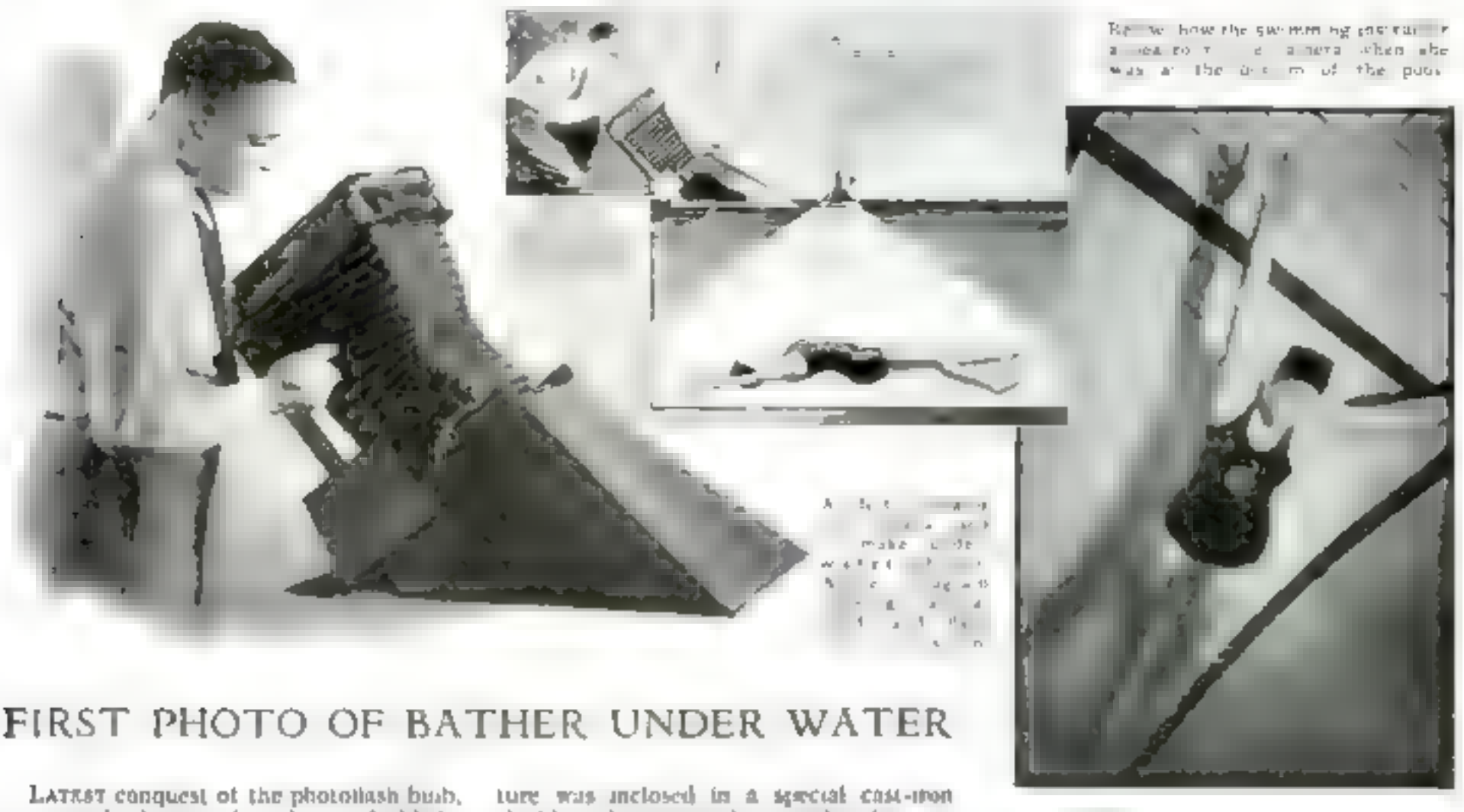
A theater on Thursday Island [illegible] of Australia, needs no ushers, for patrons take their seats according to a rigid caste system—coolies at the front, fishermen in the center, and tradesmen and business men at the rear. Malay audiences indulge in impromptu dances after the show, suiting the action to the play they have just seen and taking particular pleasure in pantomiming the actions of fist fights shown on the screen.



MACHINE FERTILIZES PLANTS

[illegible]ric current used in a new tomato pollinator [illegible] place of the feet and wings of bees and [illegible] birds. The instrument is used to scatter [illegible]om a cluster of tomato flowers so that the [illegible] dust will fertilize other blooms. Formerly [illegible] left to the insects or done by hand labor, but [illegible] gardener carries a pistol-shaped electric [illegible]nt connected to a six-volt battery. Its [illegible]g needle is held in contact with each cluster [illegible]rs, causing the pollen to fly. The device is [illegible]ntion of an Oregon gardener.

Surprising Steps in Progress of Photography



FIRST PHOTO OF BATHER UNDER WATER

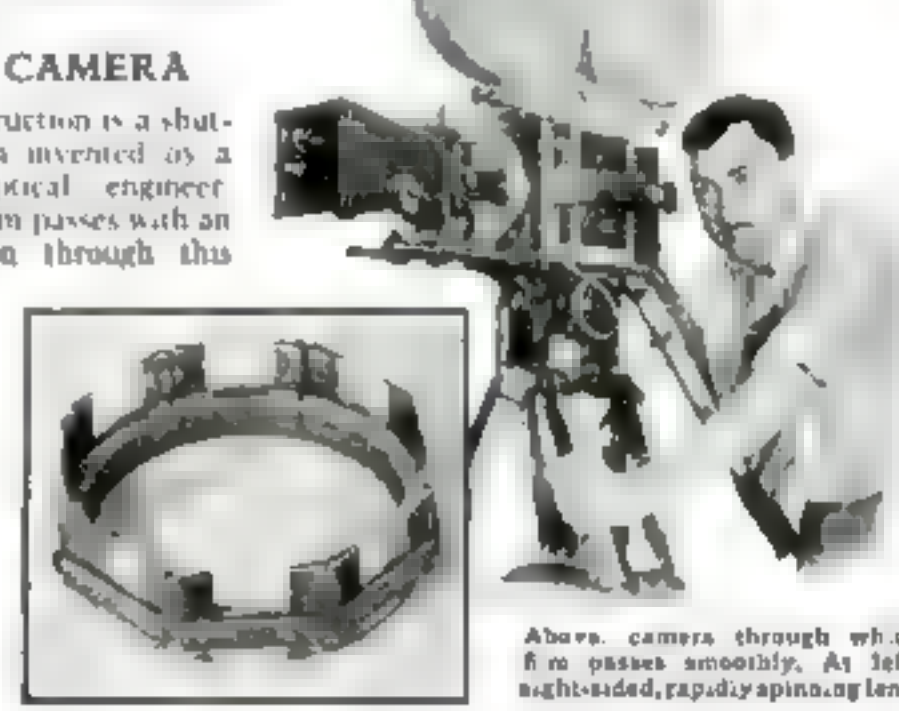
LATEST conquest of the photoflash bulb, a recently-developed aid to flashlight photography, is the picturing of an underwater swimmer in an indoor pool. This feat was accomplished recently for the first time by General Electric engineers at Cleveland, Ohio. A single photoflash lamp lowered into the Cleveland Y. W. C. A. pool gave a flash of nearly half a million candlepower. It showed Miss Jean Duncan swimming instructor just as she reached the bottom of the seven foot pool. The camera that took the picture was inclosed in a special cast-iron shield, with a plate glass window lowered into the water a few inches to avoid distortion by surface ripples. Old-style flash guns could not have been used.

DARK ROOM OF SAPLINGS BUILT IN CONGO JUNGLE

AN IMPROVISED dark room in the jungles of the Belgian Congo enabled H. C. Raven of the American Museum of Natural History to develop photographs on the spot during a gorilla-hunting expedition (see page 24). First an outline of the chamber was marked on the ground. Then porters thrust saplings into the earth, binding their tops together.

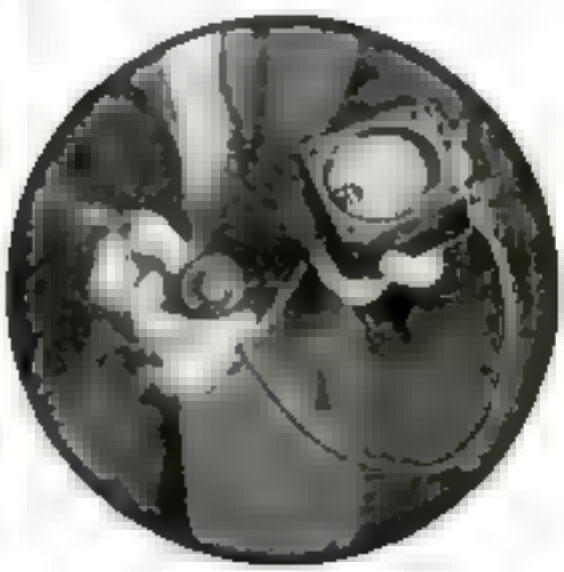
CLICKLESS CAMERA

LATEST in construction is a shutterless movie camera invented by a young Mexican optical engineer, Gabriel Moreno. Film passes with an uninterrupted motion through this camera. An eight-sided lens disk spins at high speed in the new machine, wiping one exposure after another upon the moving film. An additional refinement is a photo-electric "eye" that gages the amount of light



Above, camera through which film passes smoothly. At left, eight-sided, rapidly spinning lens.

METER GAGES LIGHT STRENGTH



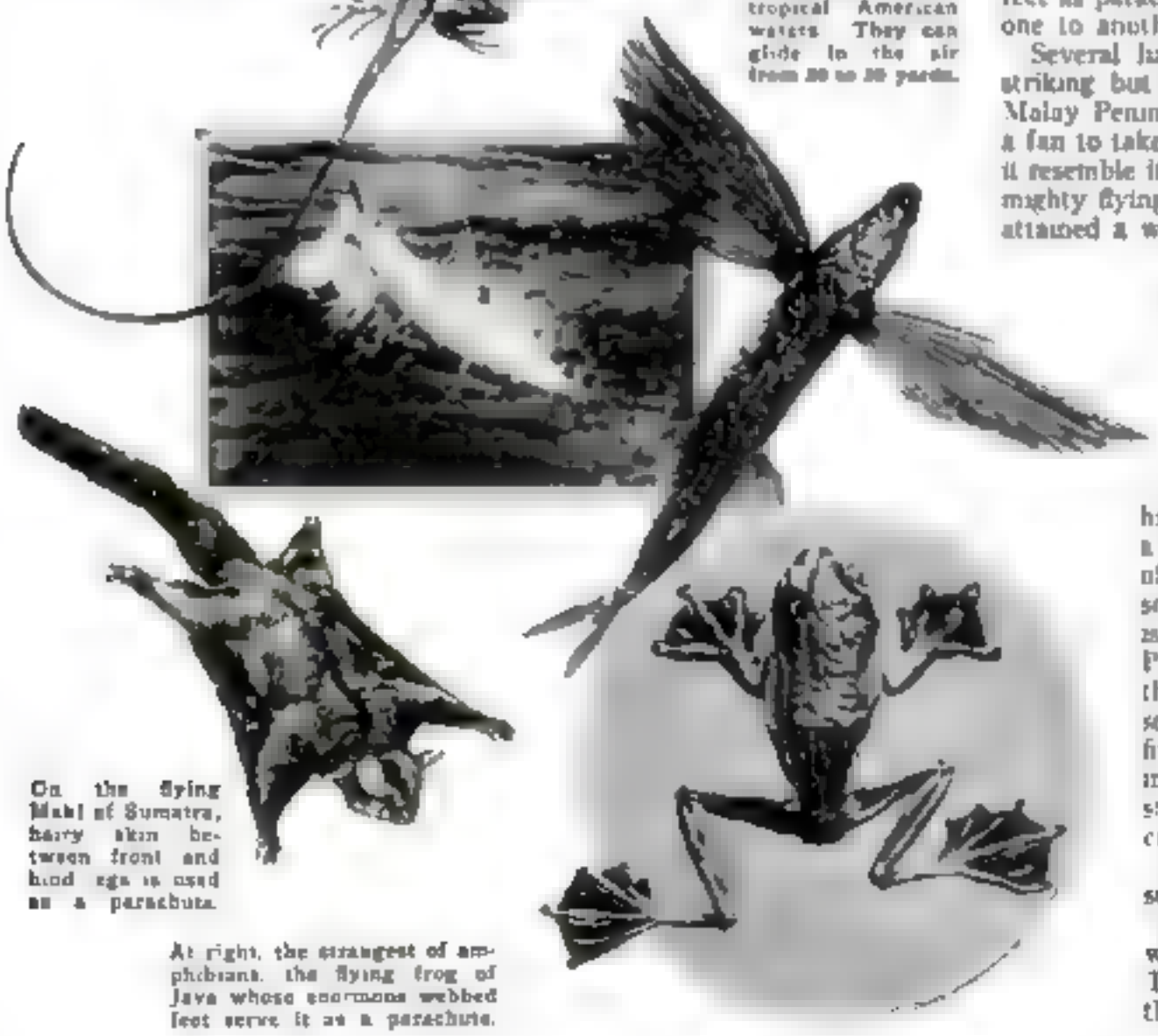
THE energy of light itself operates a meter that registers directly upon an electric dial the intensity of illumination in photographic studios, schools, public buildings and factories. It uses no batteries or outside electric connections. The heart of the instrument is a disk of copper oxide, a material which has been used by German experimenters seeking power from sunlight (P. S. M., June '31, p. 41).

Strange Animals *that* FLY

At right, hundreds of flying foxes of India are hanging with heads down.

Above the largest of all bats, called flying foxes. The one seen here has a wing spread of five feet.

Above a flying phalanger of Australia poised ready for a glide. At right is a flying dragon of the Malay Peninsula.



Below two species of flying fish from tropical American waters. They can glide in the air from 30 to 50 yards.

On the flying Mahl of Sumatra, hairy skin between front and hind legs is used as a parachute.

At right, the strangest of amphibians, the flying frog of Java whose enormous webbed feet serve it as a parachute.

AN AMAZING tribe of aerial creatures, neither birds nor insects, again challenges evolutionists to explain it since a "flying snake" that sails through the air of Borneo jungles was recently described by Dr Raymond L. Ditmars, curator of reptiles at the New York Zoological Park. Now practically all the higher branches of the animal kingdom are represented by some species that either flies or glides.

Just as a cat runs up a tree from a dog so the flying fish of American tropical waters leaps from the surface to escape larger fish that would devour it. On winglike fins it soars as far as fifty yards.

The strange "flying frog" of Borneo and Java, only flying amphibian known, uses enormous webs on its feet as parachutes. It lives in trees, and soars from one to another.

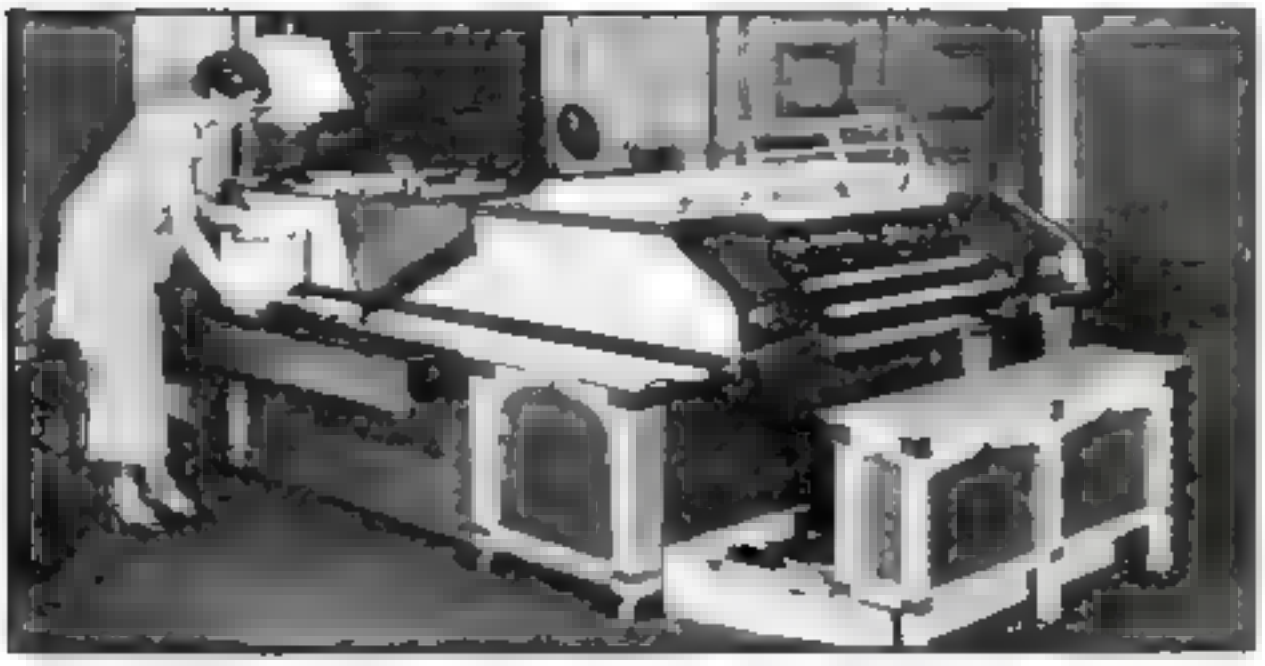
Several lizards have some power of flight. The striking but harmless little "flying dragon" of the Malay Peninsula spreads membranes on its ribs like a fan to take flying leaps through space. Little does it resemble its reptilian predecessors of past ages, the mighty flying lizards known as "pterodactyls," which attained a wing spread of more than twenty feet.

No specimen has ever been captured of Borneo's flying snake, but observers have seen it stiffen its body and glide from a tree on its concave stomach to escape a species of hawk that eats it.

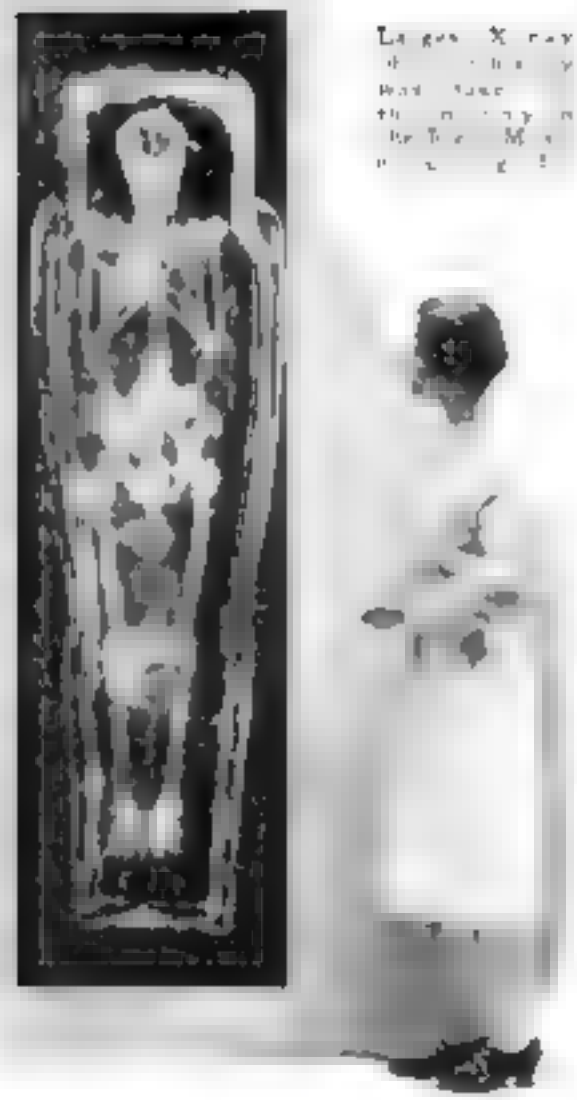
Mammals number the most flying forms. North America's flying squirrel, a nocturnal animal, soars on a membrane stretched between front and hind legs. So do the "flying phalangers," a large group including the "flying mice" of Queensland and the so-called "flying squirrel" of Australia. A champion glider is the misnamed "flying lemur" of Indo-Pacific regions, an amazing creature about the size of a cat. It has been seen to soar seventy yards with a drop of only thirty-five or forty feet. To visualize this feat imagine leaping from a third- or fourth-story window and gliding the length of a city block.

Bats are the only mammals capable of sustained flight. Largest of them all, the "flying foxes" of the Orient, of five-foot wing spread, hang head downward by day. The true flying lemur of Madagascar takes thirty-foot leaps through the air.

Electricity Runs New Player Pipe Organ for Home



Designed on the principle of the player piano, a compact new pipe organ for home and school plays music automatically from a flexible roll. Because of its unique feature, the "reproducing organ" will bring into the home an entire symphony, which, if played by hand, would require the services of a whole group of artists. All of their movements may be recorded upon a single roll. The organ is expected to be of especial value in schools. Pupils of music appreciation classes are enabled to hear the compositions of masters played by famous musicians and recorded for the purpose. Electric mechanism works the instrument.



Large X-ray [illegible]

FIRST PLANT PATENT GOES TO NEW ROSE

"Plant Patent No. 1" has just been granted to Henry F. Bosenberg of New Brunswick N. J. for an everblooming rose named "New Dawn." It is the first to be issued under a law passed by Congress last year putting the discoverer or breeder of a new plant on the same footing with the inventor of a new machine. A plant inventor is entitled, according to the law to "the exclusive right to reproduce, use, or sell his invention or discovery throughout the United States and its Territories for a period of seventeen years." Instead of blooming once each year the new rose blooms repeatedly in the fashion of "everblooming" tea roses. Otherwise it resembles a variety well known as the Dr Van Fleet climbing rose. It is the everblooming feature upon which the new patent has been granted. While it is intended to encourage American horticulturists the new law is likely to raise difficult questions for the Patent Office as to what is patentable. A new color a slight variation in color or double blossoms may cause a breeder to apply for a patent. Seed plants and those propagated by tubers are not covered by the new law which designates as "plants that are not raised from seeds

Taking advantage of a law passed by Congress a New Jersey man has patented this new rose.

BIGGEST X-RAY PICTURE IS MADE OF MUMMY

What is said to be the largest X-ray photograph in the world has just been made by experts of the Field Museum of Natural History, in Chicago. It was taken upon a film seven feet long and two feet wide, and shows an entire adult Egyptian mummy in its casket. Only one exposure was necessary. Hitherto mummies have had their X-ray pictures taken at museums in fourteen-by-seventeen inch sections and the resulting films are pieced together in a mosaic. Special apparatus developed at the Field Museum made the new feat possible. A long series of experiments were necessary before it was possible to make this photo-

HUMAN ENERGY IS STUDIED WITH CHEMICAL TESTS

How training makes an athlete [illegible] is being studied at a Berlin physical culture school with such strange apparatus as this test outfit mounted on a bicycle. While the runner trots along a track wearing the special breathing mask shown in the picture an observer on a bicycle keeps pace with him. Air exhaled by the runner is collected in the cabinet on the handlebars and at the end of the run is chemically analyzed. This and other tests have shown that trained athletes have developed an increased lung capacity, a lower pulse rate an enlarged or "athlete" heart and blood that is richer in red corpuscles than is possessed by the untrained and unathletic person

Weird Unseen RAYS

By Edwin W. Teale

Bits of a car's broken headlights put under ultra-violet rays cleared an innocent driver of a charge of killing.

IN NEW YORK CITY, not long ago, perfume bootleggers hatched what they thought was a perfect plot, one that was absolutely undetectable.

Under direction of the gang, a small glass factory turned out imitations of the bottle used by a noted perfumer in selling one of his rare blends at $100 an ounce. Filling these with a cheap substitute, the crooks played their trump card.

Instead of counterfeiting the labels, they bribed the perfumer's printer and obtained the original plate he had used. As a result, not even the most powerful microscope could find the slightest difference in the exteriors of real and bootleg bottles. The gang thought detection impossible. And it would have been but for a dramatic new weapon recently enlisted in the war against crime.

In his New York City laboratory, Dr. Herman Goodman, skin specialist and a pioneer in this thrilling new method of scientific crime detection, examined bottles brought by the frantic manufacturer.

He carried them to a darkened room, approached a gleaming dome of polished metal, and snapped on a switch. Strange purplish light streamed from the dome. Into this circle of ultra-violet rays he pushed two bottles, one genuine and one counterfeit. The effect upon the labels was bewildering, fantastic. The slips of paper glowed with a weird light, like the dial of a radium watch. One label shimmered with a bluish tinge, the other with a yellow hue.

IN PRINTING the labels, the gang had used an ink that appeared to the naked eye to be identical with the original. But, under the bombardment of ultra-violet rays, its different chemical composition caused it to glow with a yellow hue, instantly setting the labels apart. By quick examination with an ultra-violet lamp, the perfumer weeded out fake bottles in stores that had been duped, without the costly process of opening each container. Getting the jump on the crooks, he ran the gang to earth before it could sell many of the fake bottles.

This is only one of a score of amazing achievements recently chalked up for this latest crime detector to come from the laboratories of science. The use of rays is the newest thing in criminal hunting. X-rays, piercing through solids to find hidden clues, strange, "one-plane" polarized light, making possible a startling new

Invisible rays aid detectives in finding the woman to a crime, as human hair glows in different colors when seen under the powerful light as is pictured above.

Trap Master Crooks

How "Black Light" Brings New and Strange Magic to Aid Scientifically Trained Police in Solving Mysterious Crimes

Dr. Pacent, ray expert of the Crime Prevention Laboratory, Chicago, making a polariscopic analysis of alkaloids by which clues are traced and criminals found.

At top, expert is using petrographic microscope to identify minerals. Above, portable black light outfit used to find clues

method of tracing dust and minerals; mysterious ultra-violet "black light," ferreting out evidence through the sheen and glow of common minerals—these are now major allies of the law.

On a recent 2,000-mile trip, I visited laboratories where white-robed super-sleuths employ these little understood vibrations of the ether to solve baffling crimes. In their darkened chambers, I witnessed the first offensive in a thrilling new attack upon criminals.

All of these rays are formed by electromagnetic vibrations and differ only in wave length. Polarized visible light, the only one of the three seen by human eyes, has the longest wave length, X-rays has the shortest, with ultra-violet falling between.

In the whole world, one authority told me, there are today less than half a hundred detectives trained to capture crooks with these new weapons. Yet, tomorrow, ray-using Sherlocks will be a part of the detective systems throughout the world. Already, a list of their achievements reads like a page from some scientific Arabian Nights.

Take the solution of the "Bandana Murder Case," in the Middle West, not long ago. Motorists, stopping to change a tire on a side road, discovered a body lying in the ditch, a bullet through the head. There were signs of a struggle, and a single clue, a red bandana handkerchief caught on bushes through which the slayer had escaped.

The victim proved to be a miserly rich man who was foreclosing on farms in the neighborhood. He had many enemies. Threats had been made against him. All those who might have had cause for committing the murder were held on suspicion.

IN THE meantime, the handkerchief into which grayish lines of dust had been caked by perspiration, moved to the center of the stage. The intelligent chief of police, realizing that the reputations of many men were at stake, took extra precautions and rushed the bandana to another city for examination by an expert.

He followed this scientific sleuth to his laboratory, watched him slip the cloth under an ultra-violet lamp and switch on the rays. Then the amazed officer saw the dust burst into lines of indigo fire. Watching the intense, vivid blue for a moment, the expert turned to him with a single word: "Feldspar."

Samples of dust from the farms of suspected men were next placed under the rays. They glowed in various hues, most of them showing the presence of feldspar, but none reacting to the light with the exact shade of the bandana particles.

Not far from the scene of the murder, there was a large clay pit from which laborers dug material for a pottery factory. Samples of this clay were placed under the light and burst into the exact sheen of the original dust. A speedy round-up of the workers resulted in the capture of the culprit. He had shot his victim during a struggle in an attempted holdup. As he fled from the scene, the bushes tore the bandana mask from his face and this square of cloth, by the witchery of "black light," became the dramatic witness that convicted him and freed a number of innocent men.

Of the three "detective rays," those of ultra-violet are by far the most versatile. Studied seriously only since the war, these vibrations have found a thousand tasks to do. Almost every

substance in the world glows, or fluoresces, with a distinctive color when they strike it. At the Scientific Crime Detection Laboratory, in Chicago, I watched white powders turn brilliant orange, vivid purple, blood red when touched by the invisible rays.

IN HIS New York office, Dr. Goodman, who trapped the fake perfumers, showed me 20,000 specimens he has tested in this way. Every color of the rainbow appears, but shades of blue predominate. Why do things fluoresce? That is still a mystery. But the fact that they do is proving of incalculable benefit to the scientific trailer of desperate men.

At the scene of a crime a bit of leather, a scrap of paper, a single hair may prove the key to a mystery. By using "black light," as the scientific detectives call ultra-violet rays, the expert can frequently pin such bits of evidence to a suspect. For leather, tanned by different processes, glows in different colors; paper, kept under different storage conditions, fluoresces with varying hues; and hairs that seem the exact shade under ordinary light shine in different colors when exposed to the emanations of ultra-violet.

A few weeks ago, a sensational story was printed. "Scarface" Al Capone, it said, had hired a double, whose face had been cut in exact imitation of the gangster's to serve his prison term while he remained in hiding. This fantastic plot, if it were tried, could be exposed in an instant by ultra-violet light, I was told. Old scars, such as Capone's, fluoresce a dull blue white newer cuts do not

Bits of glass that appear to have come from the identical windowpane when viewed in daylight, often glow with various hues under ultra-violet, thus proving their different origin. Early one morning a milkman in the East found a body lying at the side of the street. It had been hurled there sometime during the night by the machine of a hit-and-run driver

SCATTERED near the spot were bits of broken glass from the shattered headlight of a car. Not far down the same street, detectives found a machine in a garage with a broken headlight. The glass they had picked up in the street seemed identical with the few fragments still sticking in the frame on the suspected machine In addition, they learned that the owner had driven in late the night before

His story was that he had been driving in the country On a gravel road, he said a stone was thrown up by a passing car and smashed his headlight. Few people believed that explanation until the glass found near the body and the fragments discovered in the frame were placed in "black light." Under these rays, the street glass revealed a greenish tinge that the other lacked, removing suspicion from an innocent man by proving positively the scattered bits had come from a different headlight

By such examination, fake marble can be told from real imitation silk from the product of silkworms; and in one case flour found on the clothes of a suspect, which he claimed came from a certain mill, reacted differently to rays from the actual product and proved him a liar.

Secret Message

Using invisible ink a blackmailer wrote this message on the bottom of what appeared to be an ordinary business letter Ultra violet light brought to view the hidden writing

Are these teeth from white, yellow, or colored race? Ultra violet will tell you as the white teeth shine green the Chinaman's teeth shine yellow, and the negro's glow red orange when crushed to powder and put beneath the mysterious invisible light

Even in following the old maxim "Find the woman," ultra-violet rays may play a part. It has been discovered that hair from the head of a natural blond may fluoresce with a dozen different hues, but that from a bleached blond will always shine with the same bluish glow

SUPPOSE you found the body of a murdered man lying in a disordered room and under the fingernails of one hand tiny fragments of dark skin, clawed from the assailant during the struggle? How would you use those pieces of skin, no larger than a fly's wing, to track down the murderer?

That was the problem facing detectives in an Eastern city, a few months ago They succeeded in capturing the slayer with hardly another clue by the use of ultra violet rays. Was the skin from a negro or a deeply tanned white man? That was the first problem. Experts have discovered a strange fact: the skin of a white man fluoresces under ultra-violet light only when it *is not tanned*, while the skin of a negro glows only when it *is sunburned*

Under "black light," the minute particles burst into a telltale sheen proving the slayer was a negro who was sunburned. As it was winter at the time he must have been a recent arrival from the south. On the basis of this clue, the police rounded up all new arrivals and one with a scratched face later confessed to the murder.

SUCH bewildering achievements are not the result of chance. Day by day, scientific detectives in scattered ray laboratories are cataloguing information that the future sleuth will have at his finger tips. All the flours and common industrial dusts of France, for instance, have been studied under ultra-violet light by Edmond Locard, the famous scientific sleuth of Lyon.

At the Scientific Crime Detection Laboratory of Chicago, feathers of birds and minerals of that region are undergoing similar scrutiny Dr August J. Pacini, whose Chicago laboratory has reported remarkable achievements in crime solution, is compiling data on poisons studied with rays. In intestines, he has been able to detect small amounts of morphine and mercury compounds by using ultra-violet light and a quartz-lens microscope.

He also reports that the three common narcotics can be told apart instantly by their fluorescence, morphine glowing with a blue sheen, cocaine with a white light, and heroin with a yellow hue.

In Dr. Goodman's New York laboratory, special study has been made of rouges and cosmetics. Of more than 200 investigated, the fluorescence of many made detection unmistakable. He has also made another discovery that may play an important part in running down clues in some future murder mystery When manicured nails are seen under ultra-violet light, he reports, the expert can estimate the time that has elapsed since the polish was applied

PROBABLY the strangest story I heard in the ray laboratories of these modern Merlins concerned the remarkable capture of the "Kissing Bandit" near Chicago. This Don Juan among highwaymen preyed on women returning home after dark. He would relieve them of their money at the point of a pistol, then clap a gloved hand, which left no fingerprints, over their mouths to prevent a scream, and give them a kiss on the cheek as a final flourish to the holdup.

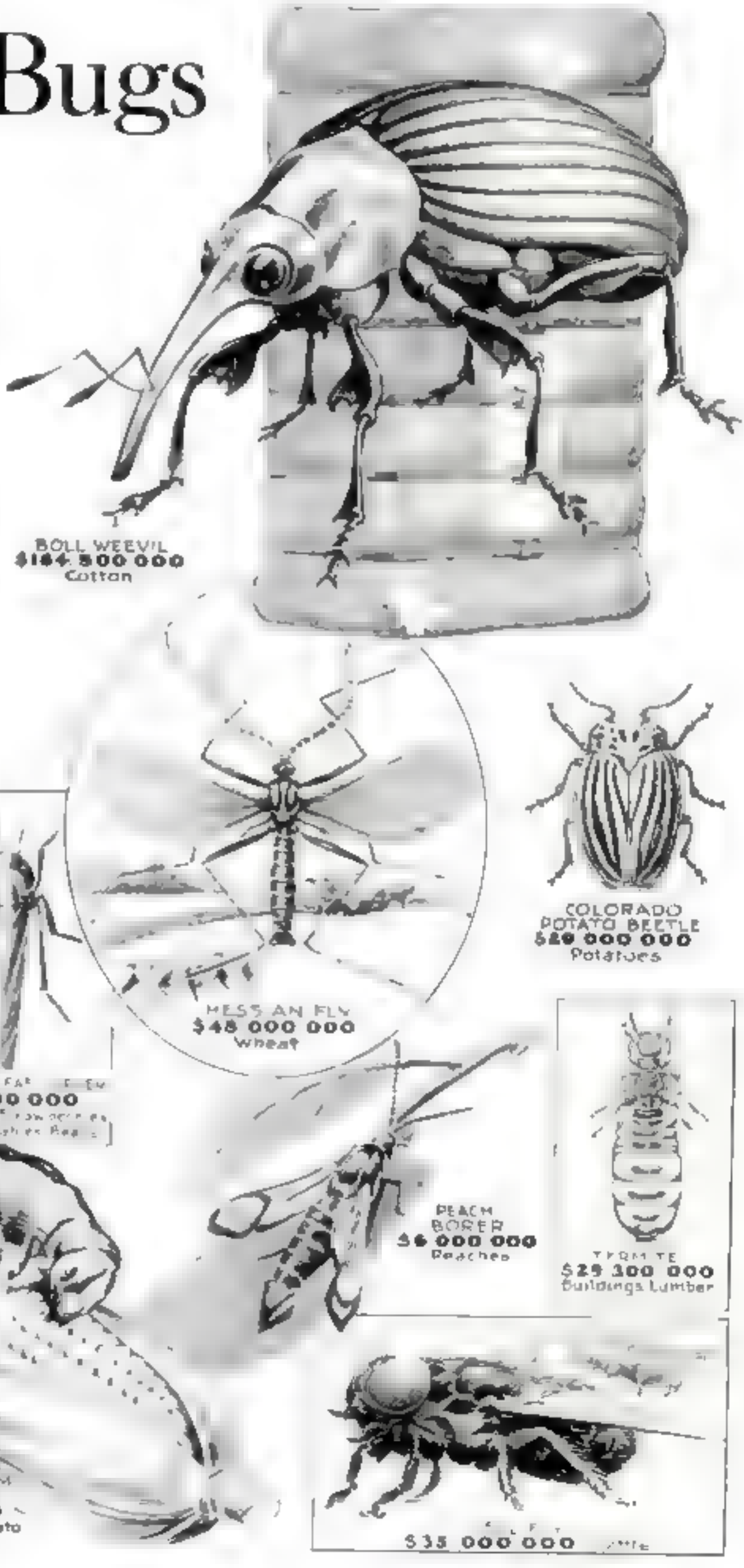
For more than a month, this phantom robber continued to evade the police. Then, one night, the special squad detailed to run him down arrested a well-dressed youth five blocks from the scene of the latest stickup. He protested his innocence, had a good alibi, and was on the point of being released when one of the detectives suggested a novel test.

The suspect's gloves were taken to a laboratory and placed under an ultra-violet lamp. The watchers saw a queer elongated spot across the palm begin to glow with peculiar brilliance. The girl who had been the victim of the robbery was next placed under the "black light" and the rouge on her lips fluoresced with the precise *(Continued on page 137)*

AMERICA *Pays* $900,000,000 *a* Year *to Feed*

H*ungry* Bugs

IF EVERY man, woman, and child in the United States were to contribute $7.32 to the national treasury, the $900,000,000 total would just about equal the yearly food bill of this country's major insect pests. This staggering figure, just announced by J. A. Hyslop of the U. S. Department of Agriculture, is based on estimates of harm done by thirty-four insects. They are our arch enemies among some 600 known destructive pests. On this page our artist gives a graphic picture of the damage done each year by the worst of our insect enemies. The cotton boll weevil's appetite for cotton costs us $164,500,000 annually. Not all of the major pests attack agricultural products. Termites—white ants—do $29,300,000 yearly damage to woodwork. Pests that eat tree trunks and leaves do a combined havoc of $138,300,000 yearly. Common clothes moths have a yearly bill of $10,800,000 to their discredit. The heel fly, an insect that keeps cattle from gaining weight, and ruins their hides, does $35,000,000 worth of harm each year.



On this ranch WILD

There is plenty of rodeo material in this herd of wild ones that are being driven from one of Rowell's pastures to another. Thus they are kept in fine condition

IN THE foothills back of Oakland, Calif., wild horses are trained into man-throwing outlaws. From all over the western ranges, they come by train and motor truck to the noted Rowell ranch, there to be developed into "bad actors" for the movie lots and the rodeo shows

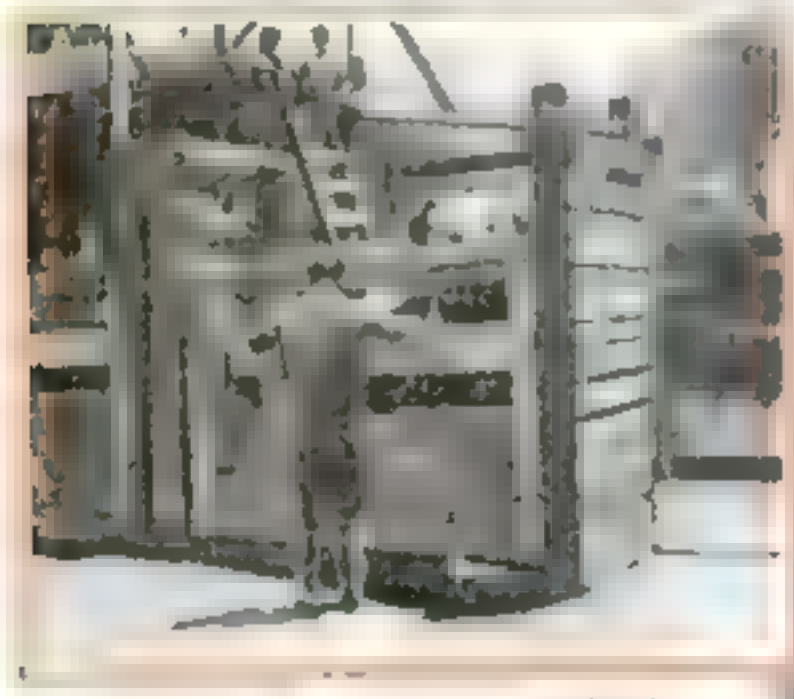
The animals that refuse to fight and are easily broken to the saddle are sold to "dude ranches and to riding academies. The vicious outlaw with the fighting heart is the prized product of this unusual training school. "The wilder they are, the better we like 'em," is the slogan of the ranch

Besides being sold to Hollywood producers for use in western "thrillers," the wild horses are one of the main attractions at the annual rodeos at Cheyenne, Wyo., Prescott, Ariz., Livermore, Calif., and Calgary, Canada. Riding a Rowell horse at one of these contests is a badge of distinction for the swaggering buckaroos who gather to try their skill.

Three or four times a year, Harry Rowell, owner of the ranch, makes a circuit of the Rocky Mountain region buying the untamed animals from ranchers and Indians. Often he has as many as 3,000 on his range. They are a fiery, colorful lot of sorrels, grays, calicos, blacks, pintos, whites, bays, and buckskins. Sometimes one of these wild ones will show unmistakable traces of the Arabian strain that came to this country with the Spanish conquistadors four hundred years ago

In handling these animals, special care is taken to cultivate their fighting and bucking ability. Spurs are never used in "hoss bustin'" at the Rowell ranch. In place of a bridle, to which might be fitted any one of a number of severe, spirit-breaking bits, a harmless halter is slipped on as an aid in catching the animals after they are "bucked out" and the lesson is ended

In accepted rodeo fashion, the wild horses get their first taste of leather at the training ranch. The "wild one" is driven into an

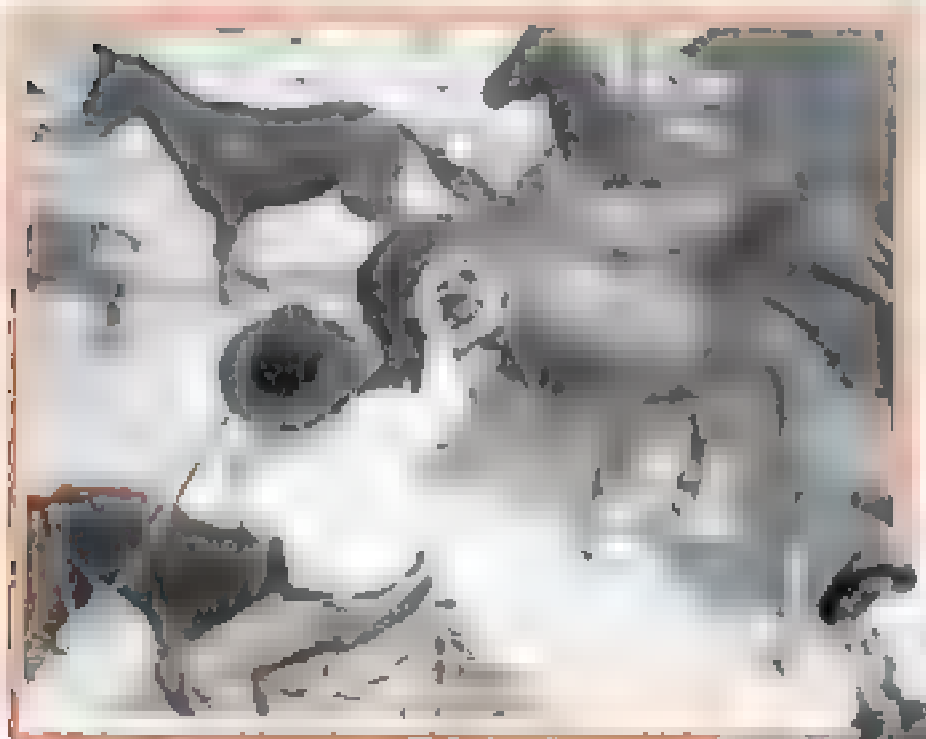


Standing in a narrow pen, the wild horse is haltered and saddled and the rider dares himself onto the outlaw's back. Then, at right, the beast comes out leaping and bucking in an effort to unhorse the cowboy

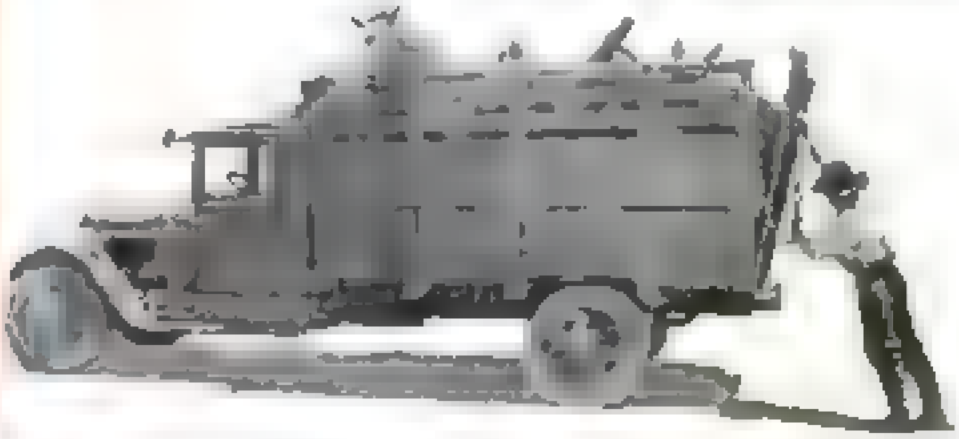
Above, with the rider gone, the horse continues to buck trying to get rid of the saddle. At right, roping on foot. A likely animal is selected and the lariat falling around its neck cuts it out of the bunch.

HORSES *are made wilder*

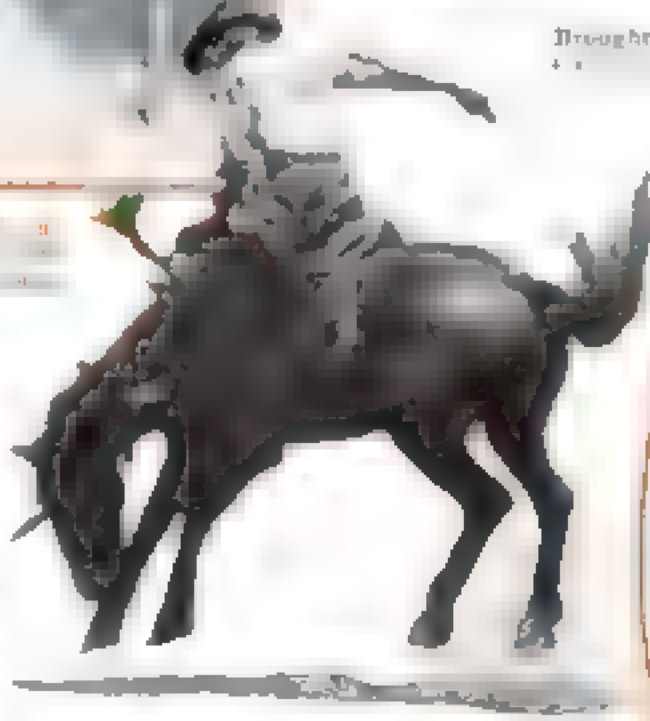
This is headquarters at the Rowell ranch and a band of horses are being driven to water by the broncho busters.



[illegible]



Brought in by [illegible] the wild ones are loaded [illegible]



[illegible]

One at a time, the horses, which may be destined to make history at some future rodeo show, are loaded into the open rear end of the truck, where they are so securely fastened that it is impossible for them either to escape or injure themselves or others.

[illegible]closure barely large enough to accommo[illegible] it, standing up. A heavily barred [illegible] mounted on stout hinges, forms one s[illegible] of the pen. One of a dozen crack riders under Rowell [illegible] the top of the pen, puts a [illegible] the animal's neck, then drops on the sa[illegible] and catches it. When all [illegible] he lowers himself into the seat [illegible] word to open the gate in front of the [illegible].

As it swings wide, out [illegible] a-fannin' and a-battin'," the rider sitting his horse as though part of it. [illegible]ing head between forelegs, the [illegible] leaps straight into the air, lands [illegible] [illegible] furiously to ditch the rider. [illegible] in these teeth-jarring tactics, it takes to weaving and "sun-fishing." If the rider is pitched to the ground then, nothing but a quick scramble will save him from the flying hoofs.

Such thrills are part of the everyday routine for the veteran riders on the wild horse range. Consequently, in the annual contests, the Rowell "bronc [illegible] [illegible]ently rank high. At the recent L[illegible] [illegible]ore, Calif., three-day rodeo, "Dutch" Bartram, "top cowboy" at the ranch, battled to the finals through a field of 500 of the toughest riders in the West. Then, by a spectacular ride on the feared outlaw horse, Nevada Kid, he nosed out Clay Carr, cowboy champion of the world, and carried off first prize as another tribute to the work at Rowell ranch.

Firemen pump water from creek into Annapolis' main reservoir during drought. At left, drilling well in effort to relieve drought sufferers.

MIRACLES Worked by Engineers in Endless Fight

By JESSE F. GELDERS

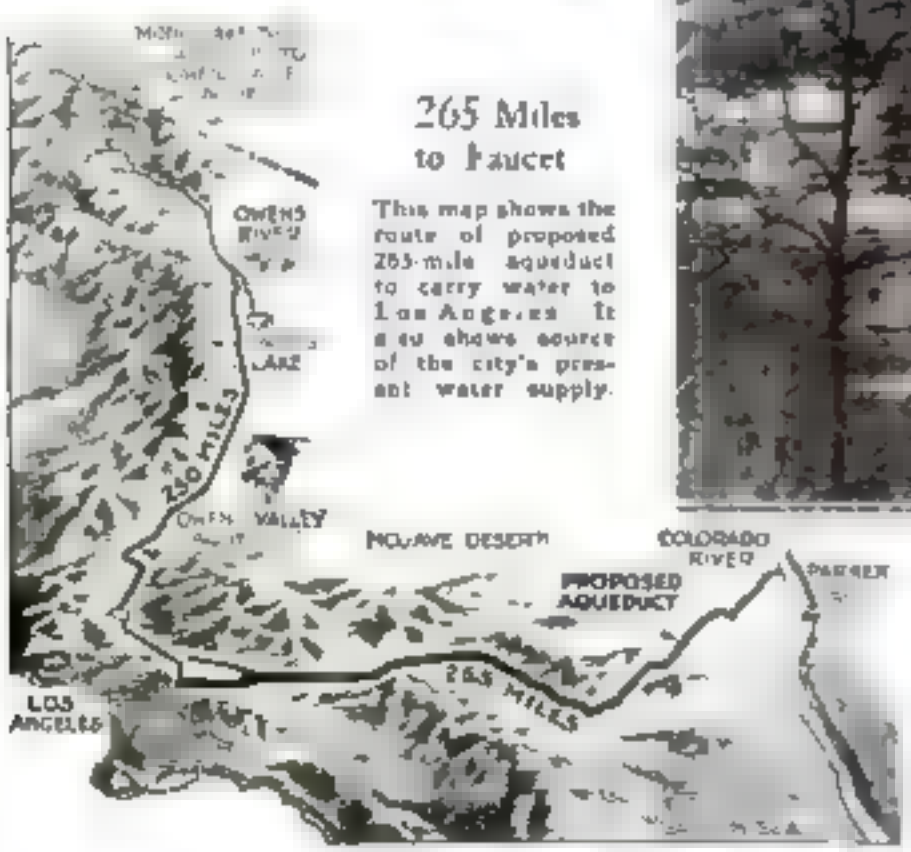
SEARING the fields of forty states, one of the worst droughts in the history of the Weather Bureau gripped the United States during the summer and fall of last year. Growing corn blistered to husks. Rivers ran dry. The contents of reservoirs, supplying great cities, sank lower day by day. Officials rationed water like war-time food and millions of people, who had taken this common fluid for granted, realized suddenly it was immensely precious.

In some places, miracles of engineering skill brought new supplies in the nick of time. Less fortunate were a number of smaller towns. With no water left anywhere within reach of their pipelines, they virtually had to have little lakes shipped to them by railway, the water coming in long trains of tank cars.

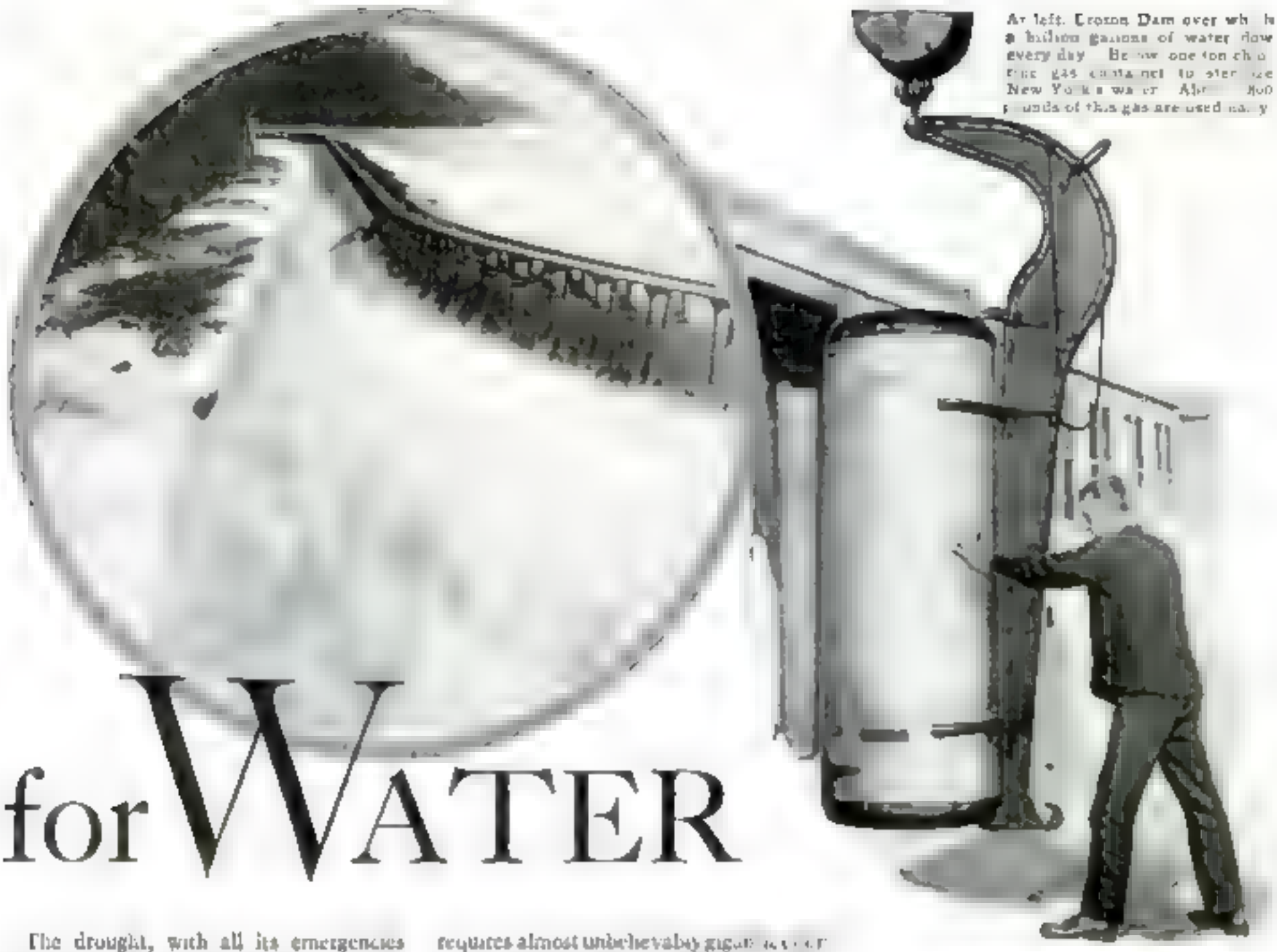
As the water famine spread over five-sixths of the country, attention was focused anew upon the continual battle to provide reserves for such an emergency, a battle that is reaching a new high point with the plans now being carried into execution.

Like air and sunshine, water is a prime necessity for plant and human life. To the city dweller it means protection against thirst, against filth, against disease, against fire. Few people, as they turn a faucet, appreciate the drama that lies behind the water they use, the labors of fighting men who blast their way through granite mountains, chain cataracts and send a Niagara of water pouring through steel pipes that spread like a network of veins below traffic-laden streets. Yet it is such labors that make possible the water supply of the modern city.

Drinking water for great city is submitted to daily tests in the laboratory to be sure no filth or disease germs have wandered into it.



Above, Lexington, Ky., is getting water from Kentucky River, raising it over 385-foot bluff by means of two pumps one of which, at river's edge, is on truck to rise or fall with the stage of water.



At left, Croton Dam over wh[ich] a billion gallons of water flow every day. Below one ton cho[rine] gas container to ster[ilize] New York's water supply. Abo[ut] 800 pounds of this gas are used dai[ly]

for WATER

The drought, with all its emergencies and its demands upon human resourcefulness, was really just one phase of a problem that engineers constantly face. About 9,000 cities and towns in the United States have regular supply systems, and every one of them represents an episode in a great struggle.

It is Man's battle to keep water within his reach. It never ceases.

NOWHERE in the world can people live in numbers greater than can be supplied with adequate water. No matter how rich the community may be, or how easily a living may be had, if its water supply is limited, so is its population.

Through more than three-fourths of the earth's surface is covered with water, most of it is unsuited for man's use. He depends upon the sun as a distillery to purify it and lift it from the sea. He depends upon the winds as a delivery system to carry it inland, where it falls as rain.

Man's struggle is to get it after it falls and before it flows back to the sea. In its mildest form this struggle involves pumping from lakes or dependable streams; or drilling wells down to intercept the water as it flows in broad sheets or buried rivers to underground lakes or the sea.

The winds are a capricious delivery system. At best they give no heed to the desire of human beings to congregate in regions of limited water supplies. It is the engineer's problem to get water from the place the wind puts it down and gravity leads it, to the place where people want to live.

Often the solution of this problem requires almost unbelievably gigantic [illegible]

Los Angeles and its neighboring cities today are preparing to build a river

They have always had the Los Angeles River, but the one they are to build will be about twenty times as large! It will bring a water supply for 7,500,000 people

It will stretch 260 miles, all the way across the state of California. Starting at the Colorado River, below the new Boulder dam, it will follow a man-made, magic course through tunnels under mountains and in concrete channels across plains. Near its start it will climb hills a quarter of a mile high, under pressure from electrically driven pumps; and then as it drops again, on its way toward Los Angeles, it will repay its power debt by turning the dynamos in hydro-electric plants along the route.

THE aqueduct that will form its riverbed will be the largest and longest ever built by any city, and will cost about $200,000,000

But the tremendous work of survey and building will take at least eight years, and that is six years longer than Los Angeles can wait for more water. At its present rate of growth, engineers estimate that the city will be using the full capacity of its present supply, and facing a shortage by 1933!

Emergency work is being rushed to bridge the gap.

For 133 years the city drew its water from the Los Angeles River. Before the day of the modern pumping plant, a wheel, turned by the stream's current, lifted water into a ditch that led into town. The inhabitants took their supplies in jugs.

Early in the present century, the weather delivery system went askew and there was a drought of several years. Los Angeles, then a city of 160,000, and growing, became alarmed.

THE chief engineer of the municipal water bureau, William Mulholland, went off in a mule-drawn buggy, prospecting. Gold was never sought so eagerly as he sought water.

Mulholland drove through the Mojave desert, and into the mountains. High up in them he found the Owens River Valley with the river emptying into a salty-shored lake

It was 250 miles from Los Angeles.

Five thousand men were put to work, building dams and reservoirs to hold the water, and an aqueduct to carry it to the city. Heavy machinery was needed, and supplies had to be taken to the men. So they built 120 miles of railroad, and 500 miles of highways and trails!

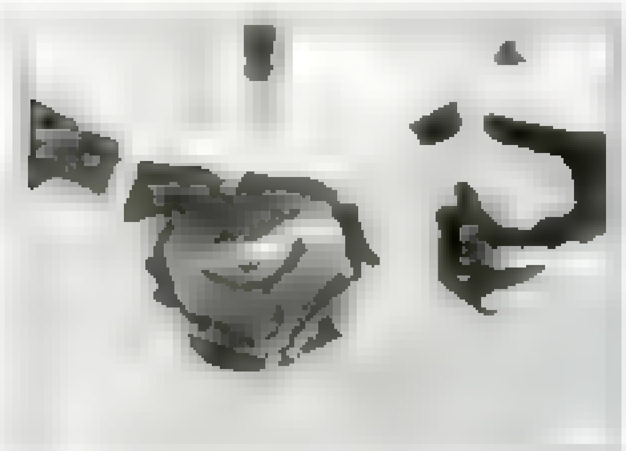
The aqueduct that was to carry water could not be constructed without water, so they built a pipeline to bring it as they went along

When they came to hills or mountains that they could not pass around, they dug through them. There were 142 separate tunnels. Valleys presented a different problem. The weight of the water going down one side could be made to force it up the other. But water pressure increases with depth. At the bottom of a 100-foot valley every square inch of pipe surface (Continued on page 141)

Parachute Jumper Photographs

• Tiny Camera with Rapid Fire Release Used by German Flyer to Make These Unusual Pictures While He Was Hurtling Toward the Ground. This Is the First Time Such Photos Have Been Made and the Results Justify the Daring Necessary to Make Them

LEAPING INTO SPACE. [illegible]

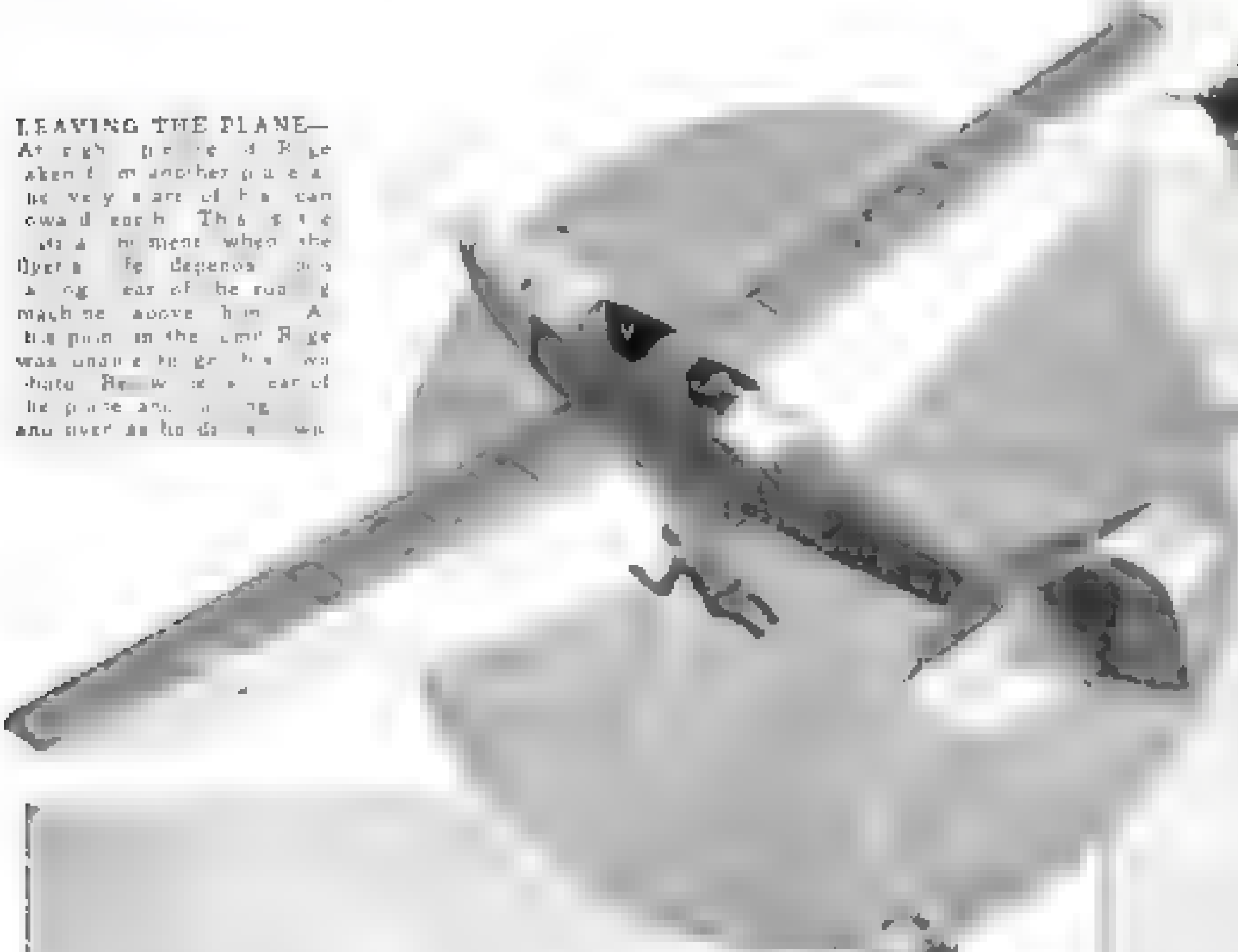


FALLING HEAD FIRST. [illegible]

CAUGHT BY THE SLO... [illegible]

[illegible] settled toward the dangerous wires.

Himself While Falling



LEAVING THE PLANE— [illegible] machine above him. [illegible]

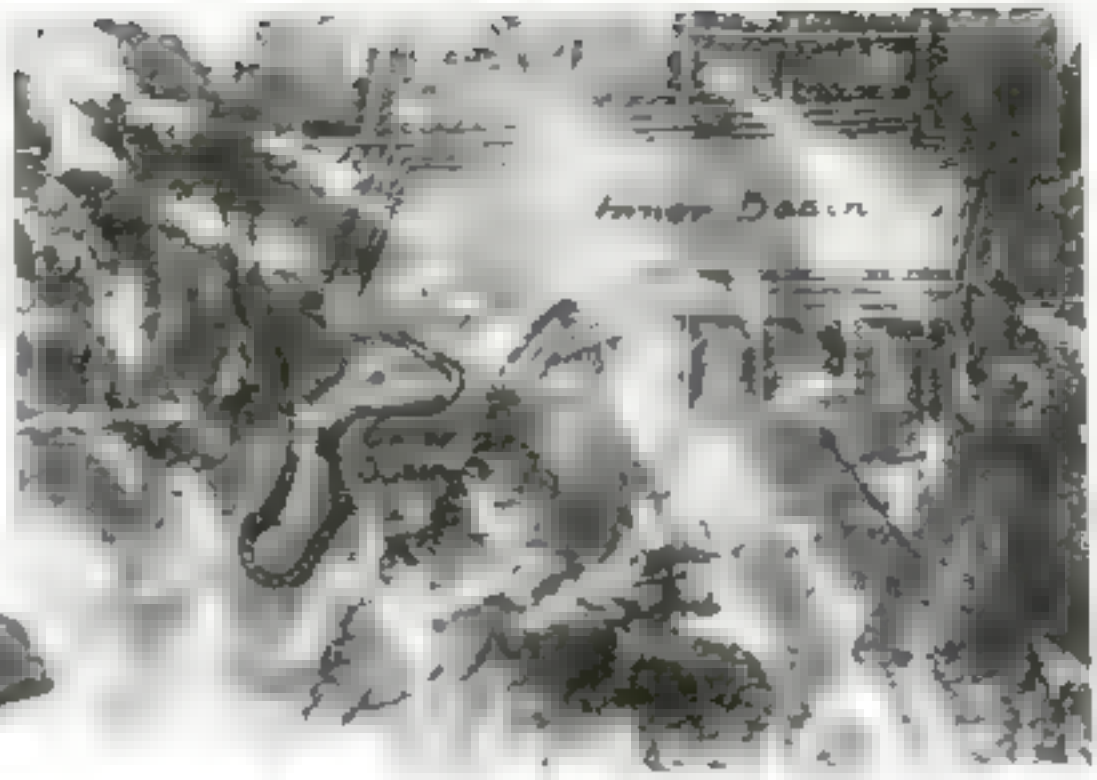
CLIMBING OUT— [illegible]

THE CHUTE IS OPEN— [illegible]

HIS WORRIED WIFE LOOKED ON— [illegible]

The remarkable photographs shown on this and the following page show how spies work after they have wormed their way into a factory. Below, a spy reads a business letter written in invisible ink

At right a plan taken by a spy and concealed with a drawing of a tree. As invisible rays hit it as shown here, the original picture becomes plain to eager



Science Outwits

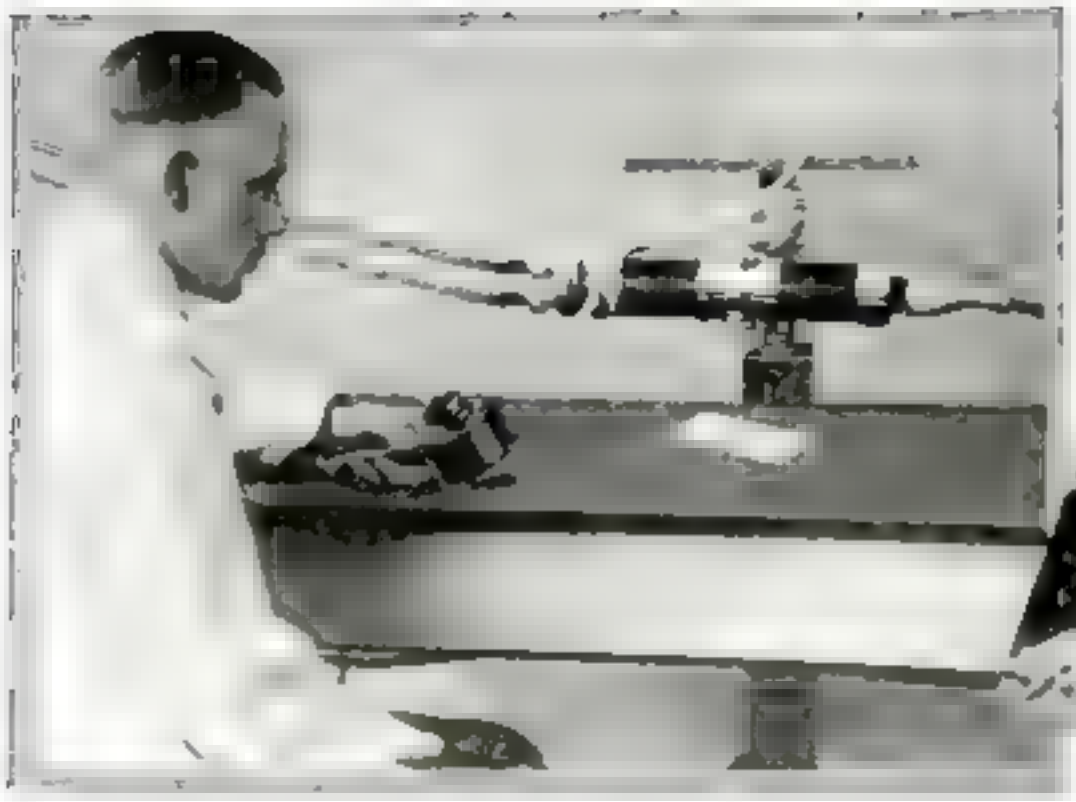
Priceless Secrets in Steel, Dye, and Chemical Plants of Germany Guarded from Sneak Thieves

At right a letter written in invisible ink is developed by treating it with chemicals so it can be read. Below, periscope system used to watch for the inventive spies

In order to hide the true nature of this stolen plan, it was overlaid with a wash drawing. Only those for whom it was intended knew how to remove the wash so valuable drawing could be seen.

Above, using a periscope to make careful observation of all that is done by suspected visitor to plant.

At left, another trap for spies is this microphone which is concealed in a lamp shade on an office desk



Steaming an envelope open to read a letter is no longer necessary. Machine shown at left produces rays that photograph the words of the letter in the unopened envelope as illustrated in the picture below. In this way enough can be read to justify further investigation.

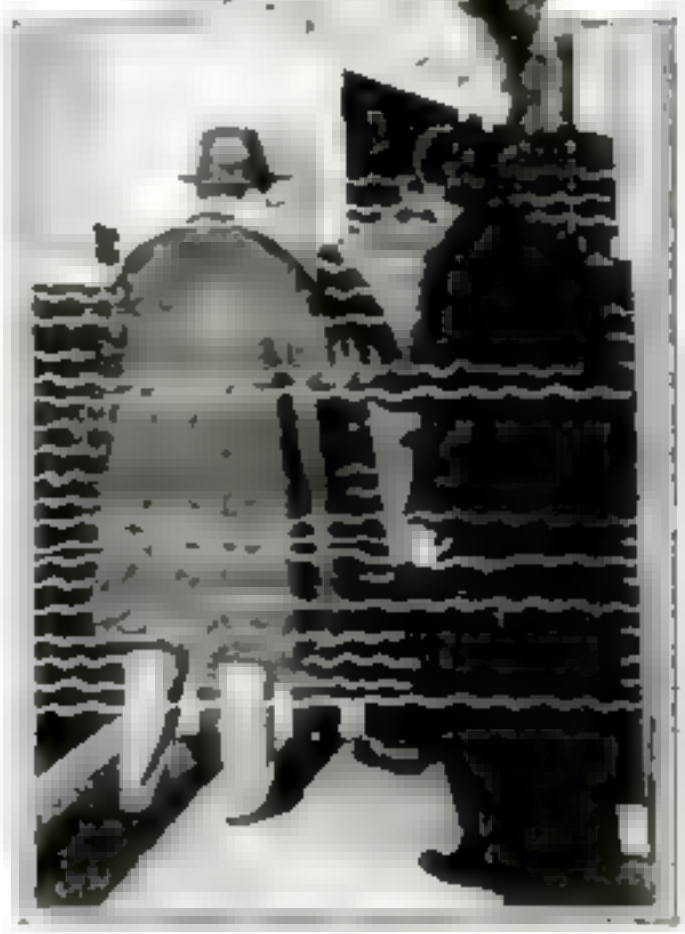
Industrial Spies

AN ELABORATE system of industrial spies, working with almost wartime efficiency, was discovered recently in Germany. In the great steel, dye, and chemical plants of that country, this organized band of informers is attempting to ferret out the closely-guarded trade secrets which give an advantage over competitors. Because of the economic crisis in Germany, these secret manufacturing processes are being more jealously guarded than ever and the factory owners are using the latest scientific aids to stamp out the crooks.

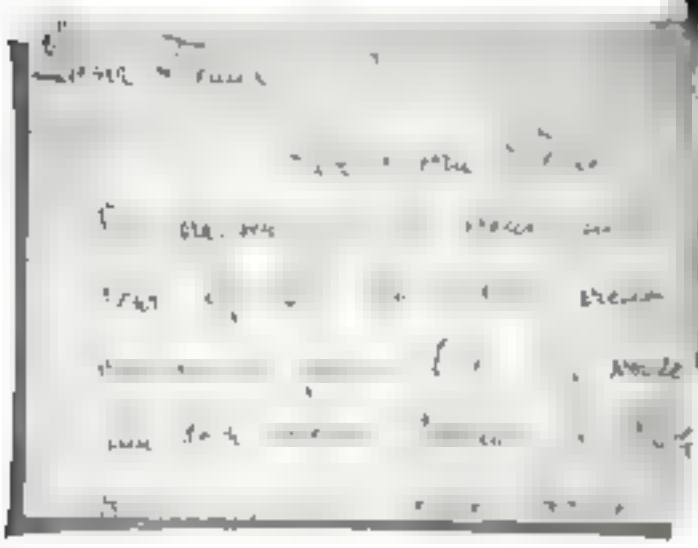
How the spy of industry operates is shown in the remarkable set of photographs on these pages. Gaining entrance to a factory on some pretext, he makes the most of the few moments at his disposal, using all the tools of modern science. If possible, a diminutive camera under his hat or in his buttonhole snaps secret industrial processes. Hasty sketches are made of an intricate machine's vital parts. He camouflages stolen plans with innocent-looking sketches of landscapes.

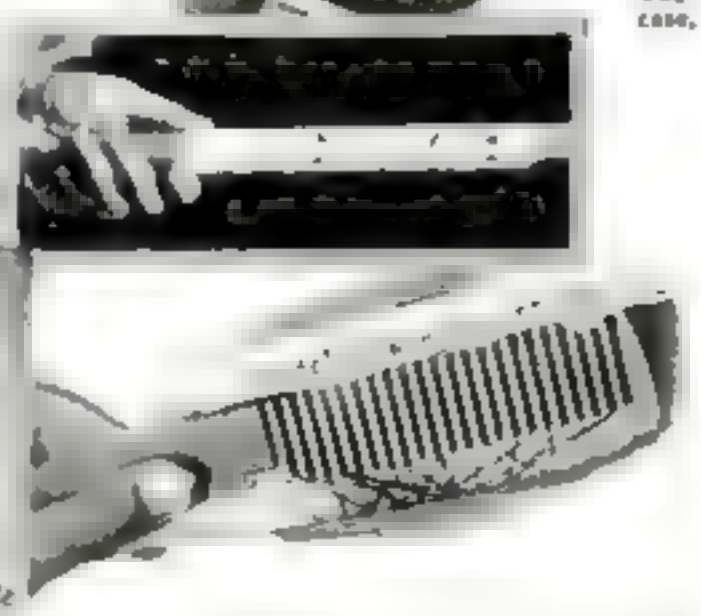
To combat him, manufacturers, when they convey valuable trade secrets by letter, use a code known only among themselves. Detectives keep unknown visitors under surveillance with tapped telephone wires, periscopes and microphones.

Below, a code message written on a long narrow strip of paper wound around a stick. It can be deciphered when wound around a stick the same length and diameter as was originally used.



As the visitors, seen above, were leaving the factory they were subjected to a barrage of X rays suggested by the wavy white lines in the picture. The purpose of this is to destroy any photographic plates the intruders may have exposed during their visit through the plant. The X rays, penetrating clothing and camera case, effectually blacken the hidden plates.





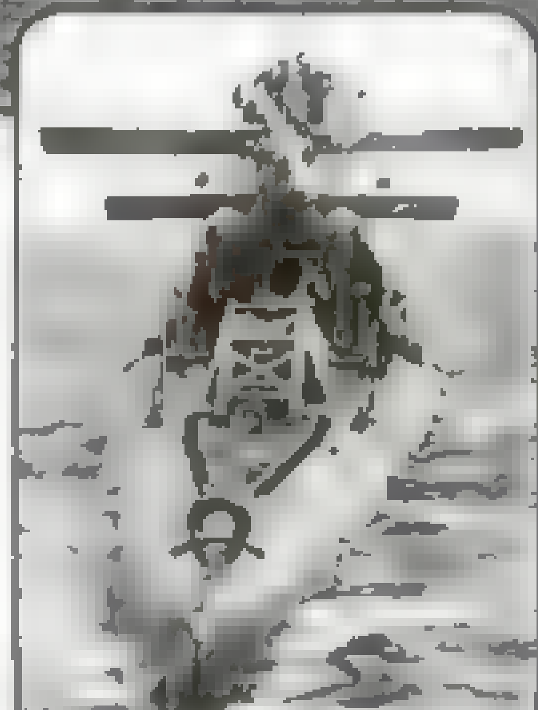
A favorite tool of the spies is shown at left. The communication is written in invisible ink between lines of an ordinary letter. Above, how a code message is sent by wrapping thread around a comb, each tooth representing a letter of the alphabet.

Note that the third button from the top on the vest is different from the others. It is the lens of a spy camera with which pictures can be taken and guarded secrets learned.

[illegible]

SUB LAUNCHES PLANE WITH CATAPULT

F[illegible] the fi[illegible] catapulted in[illegible] submarine. This [illegible] [illegible] ...ted to such [illegible] leships and cruisers. Wh[illegible] planes have been [illegible] on submarines [illegible] this purpose hav[illegible] by [illegible] by foreign [illegible] the [illegible] to stop in order to lower the [illegible] plane into the water. The [illegible] of a catapult enables the sub to send its plane into action [illegible]



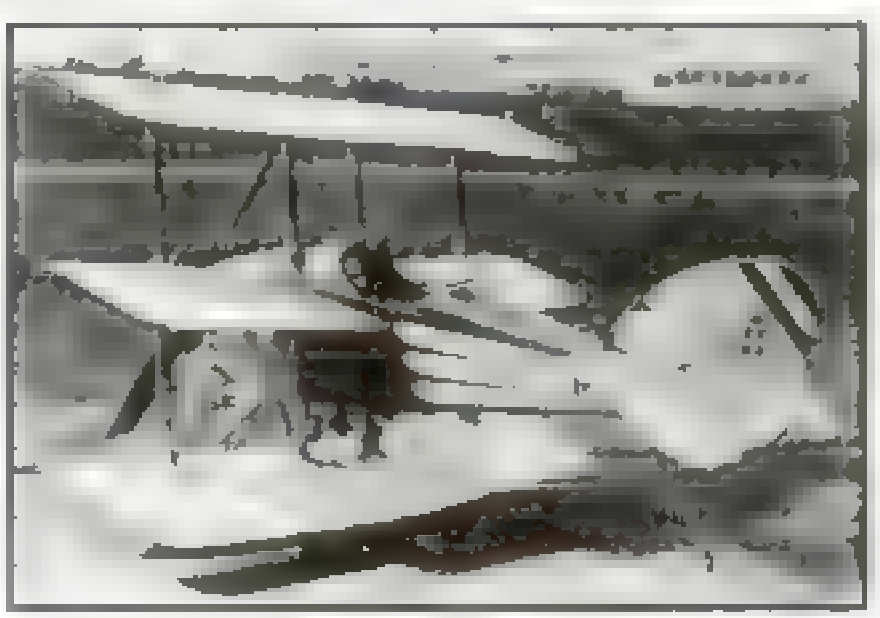
Upper right, a crane pulls plane on board when it returns. Above, plane shot into air from sub.

KNIFE NOW PART OF PARACHUTE OUTFIT

PARACHUTES used for training Army flyers at Chanute Field, Rantoul, Ill., are now equipped with "safety knives." If a flyer's parachute fouls the plane as he leaps, he can thus cut himself loose and use his emergency 'chute. In a recent accident at a Michigan field a jumper was saved by a knife passed to him from his rescuer in another plane.

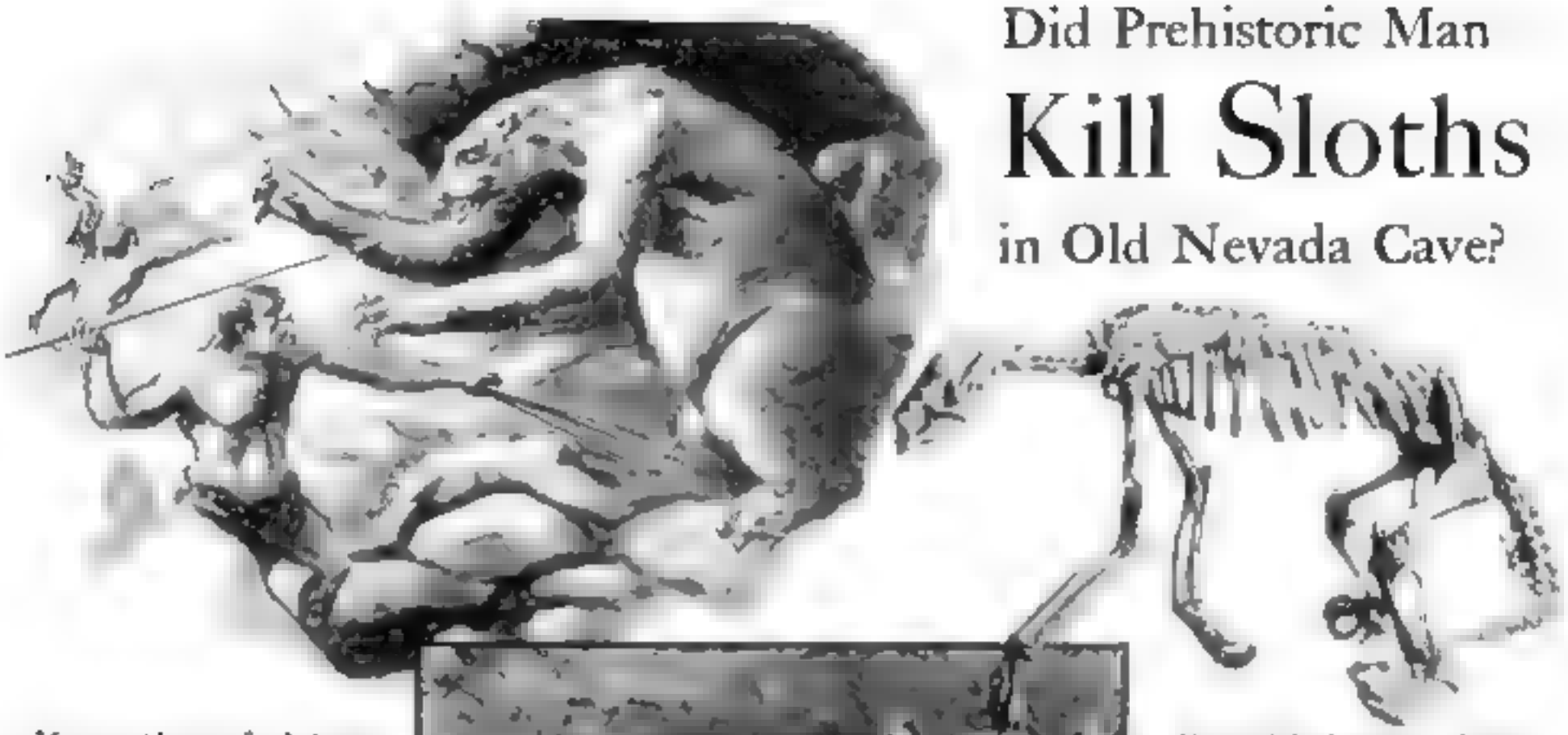
TINY TRIPLANE FITS IN ORDINARY GARAGE

NOT only one of the smallest planes ever constructed, but one of the strangest as well is a diminutive triplane recently completed at Rome, Italy. It has three sets of wings—the first beneath the fuselage, the second on the fuselage itself, and the third above it. It is small enough to be stored in an ordinary garage. It is said to fly at from seventy-five to a hundred miles an hour.



This smallest of triplanes can fly at one hundred miles an hour.

Did Prehistoric Man Kill Sloths in Old Nevada Cave?

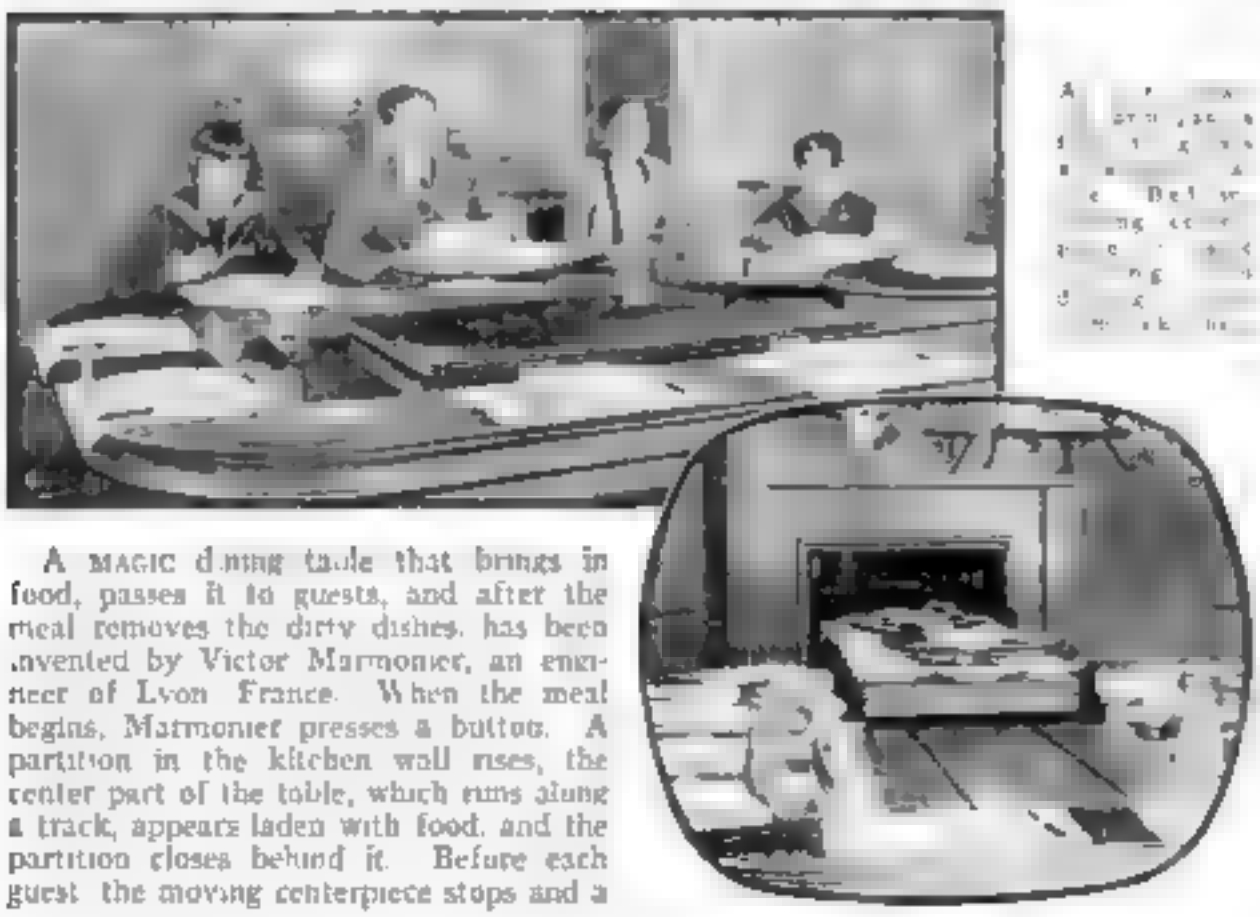


Above, skeletal remains of giant sloth found in Nevada cave. At upper left, drawing of fancied fight between sloth and early Americans.

Explorers of the Carnegie Institution, Southwest Museum, and California Institute of Technology at Gypsum Cave, Nevada.

MUTE evidence of what may have been a war of extermination by prehistoric men against giant animals has been revealed by the Carnegie Institution of Washington, D. C. Bones found by explorers in Gypsum Cave, Nev., a deep, dry cavern 300 feet long with a crystal-encrusted roof, showed that this cave must once have been the home of a great herd of giant ground-sloths. They were ponderous, slow moving animals, twice as tall as a man when standing erect, with long tails and covered with masses of coarse hair. Vegetarian in their diet, they probably would not attack a man unless cornered, when they might deliver a vicious blow with their huge claws. A surprise to the explorers of the cave was the discovery of human bones, fragments of painted dart-shafts, flint-pointed darts and remnants of an "atlatl," or throwing stick, mingled with the remains of the sloths. As a result of this evidence, according to the Carnegie Institution, "it has been suggested that a group of Early Americans may have come upon a herd of ground sloths in this vast underground cavern and waged a war of extermination." Moreover, the discovery that man and sloths apparently lived in North America at the same time, in the opinion of Dr. John C. Merriam, president of Carnegie Institution, ranks among the most interesting discoveries in archeology in America. It shows either that man appeared in America much earlier than was formerly supposed—for the sloths were thought to have become extinct before the end of the ice-age 15,000 to 30,000 years ago—or that these ponderous animals survived long past the historical date usually assigned to them. Hitherto there has been no definite evidence man was in America until a recent period

ELECTRIC TABLE BRINGS IN FOOD, TAKES OUT DISHES



A MAGIC dining table that brings in food, passes it to guests, and after the meal removes the dirty dishes, has been invented by Victor Marmonier, an engineer of Lyon, France. When the meal begins, Marmonier presses a button. A partition in the kitchen wall rises, the center part of the table, which runs along a track, appears laden with food, and the partition closes behind it. Before each guest the moving centerpiece stops and a rotating arm passes food to two persons at a time, on opposite sides of the table. At the end of the meal, the used dishes are placed on the movable centerpiece and run out through the partition into the kitchen. For years, Marmonier has made a hobby of producing labor-saving devices for his home until now he has an electrically operated machine for virtually every operation necessary in housekeeping.

TRAIN TIME TO THE DOT

SO THAT German travelers may know just how many seconds they have before the train leaves, railway officials have installed a clock in a Berlin station that gives time to the hour, minute, and second.

BRASS PLATE COUNTS AND PLANTS SEEDS

SEEDS may now be counted mechanically, instead of by hand, for tests of purity and ability to germinate. An ingenious device developed by the U S Bureau of Plant Industry, at Washington, D. C., gages their number with the high accuracy required, and then deposits them in neatly-spaced rows upon blotting paper, moss, or flannel for the growing tests. It consists of a brass plate with 100 holes, forming the top of a box connected to a vacuum pump. An excess of seeds is dumped upon the plate, the vacuum pump started, and the seeds shaken about the plate until one sticks by suction to each hole. The rest are then tossed back. With the counted seeds still sticking to the plate, it is inverted over the blotter and the vacuum pump turned off. The hundred seeds drop in regular rows upon the seed bed, ready for test. Seeds varying in size from alfalfa to peas and beans may be counted with a device of this type, according to the Government experts

RING TEACHES GOLFER RIGHT SWING

AN APPARATUS for forcing golf duffers to acquire that perfect swing, so essential to good golf, which travels on the true arc of a circle, was put on the market recently. The golfer stands inside a large tilting ring. Facing him on it is a small ring through which he thrusts the shaft of his club. Taking his stance he addresses the ball and makes a swing. As he does so, the little ring holding his club travels freely around the larger one, guiding the club and holding it to a perfect arc. The large ring is mounted on a swiveling framework and is adjustable to players of any height, from small children to tall men so that anyone can use it

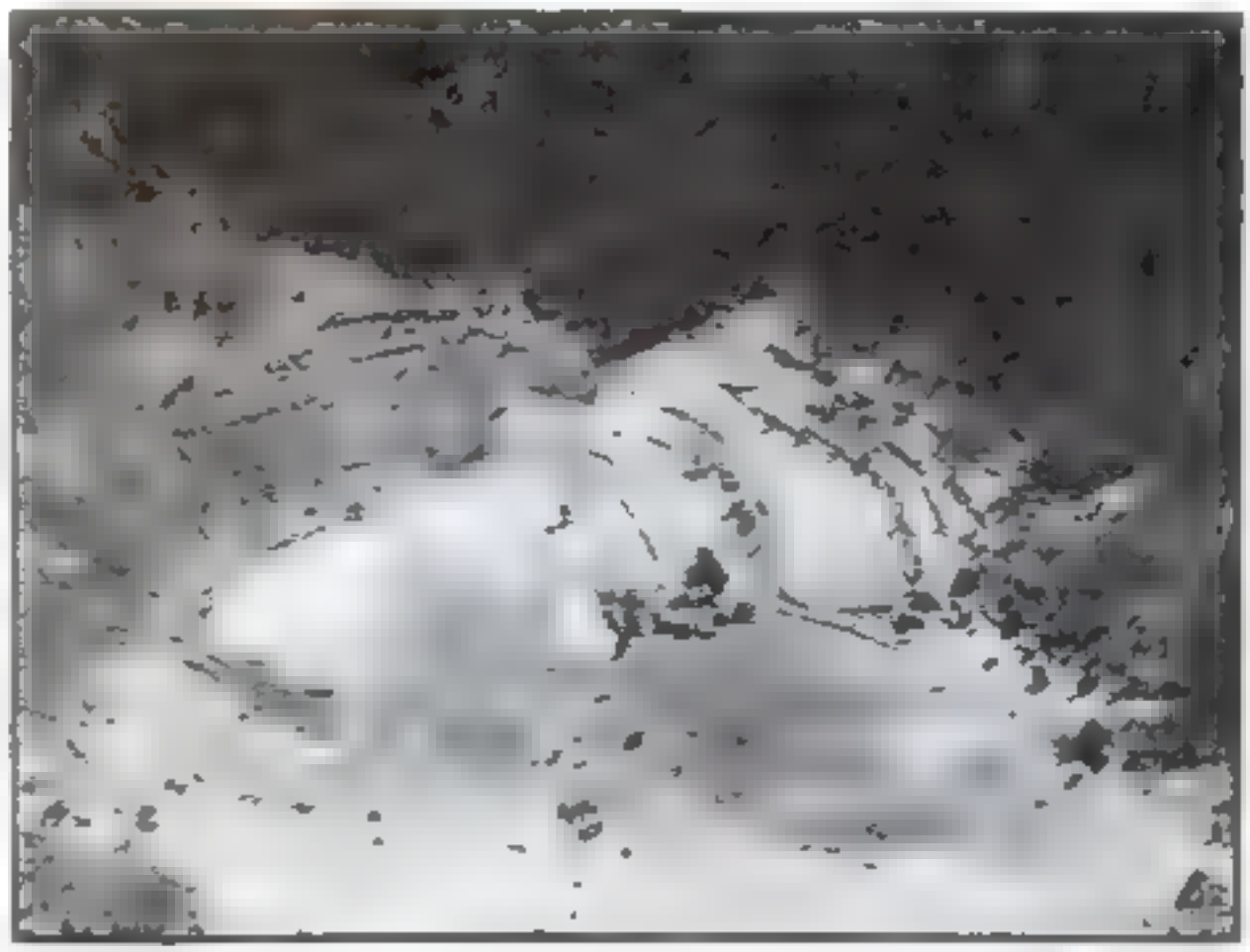
Slipping his club through the small ring the golfer's swing is controlled by the big ring so that a perfect arc is described.

MAKES TWO ENGINES OF ONE

AN INGENIOUS proprietor of a Rock Hall, Md., welding shop makes two-cylinder motorboat engines out of four-cylinder automobile motors by cutting them in two. Wrecked or scrapped cars supply the engines. Martin Wagner, who devised this method, first halves the motor completely and then welds on the necessary parts to close holes where water and oil would escape. Crank shafts must be cut in two places, to rearrange the throws, and the pieces welded together again. According to Wagner, owners of the first motors made in this way report long and satisfactory service, and estimate that in eight-hour runs the motors consume about three gallons of gasoline

STRANGEST FARM LIES IN VOLCANIC CRATER

NESTLED in the crater of the extinct volcano that forms the island of Grand Canary, of the Canary Group, lies a strange farm. Its fertile acres stretch across the floor of the enormous basin formed when the volcano became inactive. Towering ramparts of frowning rock protect it from the outer world making a remarkable contrast to the time when they were a funnel that spouted flaming lava, cinders, and smoke into the sea and sky for miles around. Just twenty-eight degrees north of the equator and about 180 miles off the northwest African coast lies this unusual island. It springs abruptly from the floor of the Atlantic many thousands of feet beneath the surface. Bananas, tomatoes, potatoes, sugar, and grapes are its chief products. This volcanic island is but one of the group to which its name is given, all of which are formed of old volcanoes that have been inactive since long before the dawn of recorded history. The buildings seen in the center of the picture are surrounded with trees that look tiny against the towering walls of rock

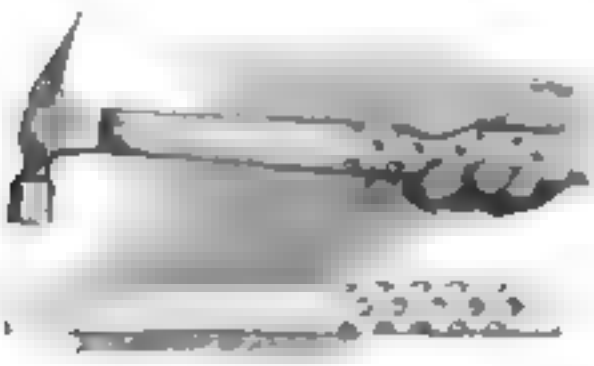


Shut in by towering walls of rock and lava, this strange farm lies at the bottom of an extinct volcano's crater on the island of Grand Canary. Here trees grow and many farm products are now raised.

INDIAN FIGHTER MAKES TALKIE OF SIGN LANGUAGE

General Hugh Scott, right, making the motions of the Indian sign language before the U. S. Department of Agriculture camera. This was one of first films made in the department's stud

EARLY history of the western American plains was relived in Washington, D. C., the other day when a movie record of the Indian sign language was made by the Department of Agriculture. General Hugh Scott, noted Indian fighter, sat at a desk and made the motions that every plainsman once knew. Was it peace or war, as white man and Indian suddenly met in a bend of the trail? Unmistakable motions of the arms, entirely different from the sign language used by mutes today, soon settled the question. The recording of this almost-forgotten means of communication between two people speaking different tongues was one of the first projects undertaken by the Department of Agriculture at its new talkie studio. It was considered highly desirable to make this permanent record before the last of the old sign talkers passed away



NEW HAMMER HANDLE HAS VACUUM GRIP

A NEW hammer handle full of small holes like a Swiss cheese makes light work for the mechanic, either amateur or professional. The holes act as vacuum cups when covered by the hand, making the grip tighter with less muscular effort. This hammer handle is said to be easier on the hands than the ordinary smooth one

USE LADDERS TO OUST RATS FROM TREES

LOS ANGELES has carried its war on r into the tree tops. Not long ago, health officials discovered that legions of the rodents had deserted their homes on the ground and taken to nesting in tall pal To reach them, a special ladder with t extensions was devised, the top sect making a horizontal platform to reach the nests without damaging the foliage of the tree. Then poison was poured by the bucketful into the nests, and after it had taken effect city trappers made a haul thousands of rats. As yet no explanation has been given by the Los Angeles animal experts for the unusual conduct of the rodents in retreating to the tree tops and establishing their homes there

HIS SCRAPBOOK IS REAL ENCYCLOPEDIA

Arthur Carlson, Brooklyn, N. Y., with his 140-page scrapbook made from Popular Science Monthly and other magazines

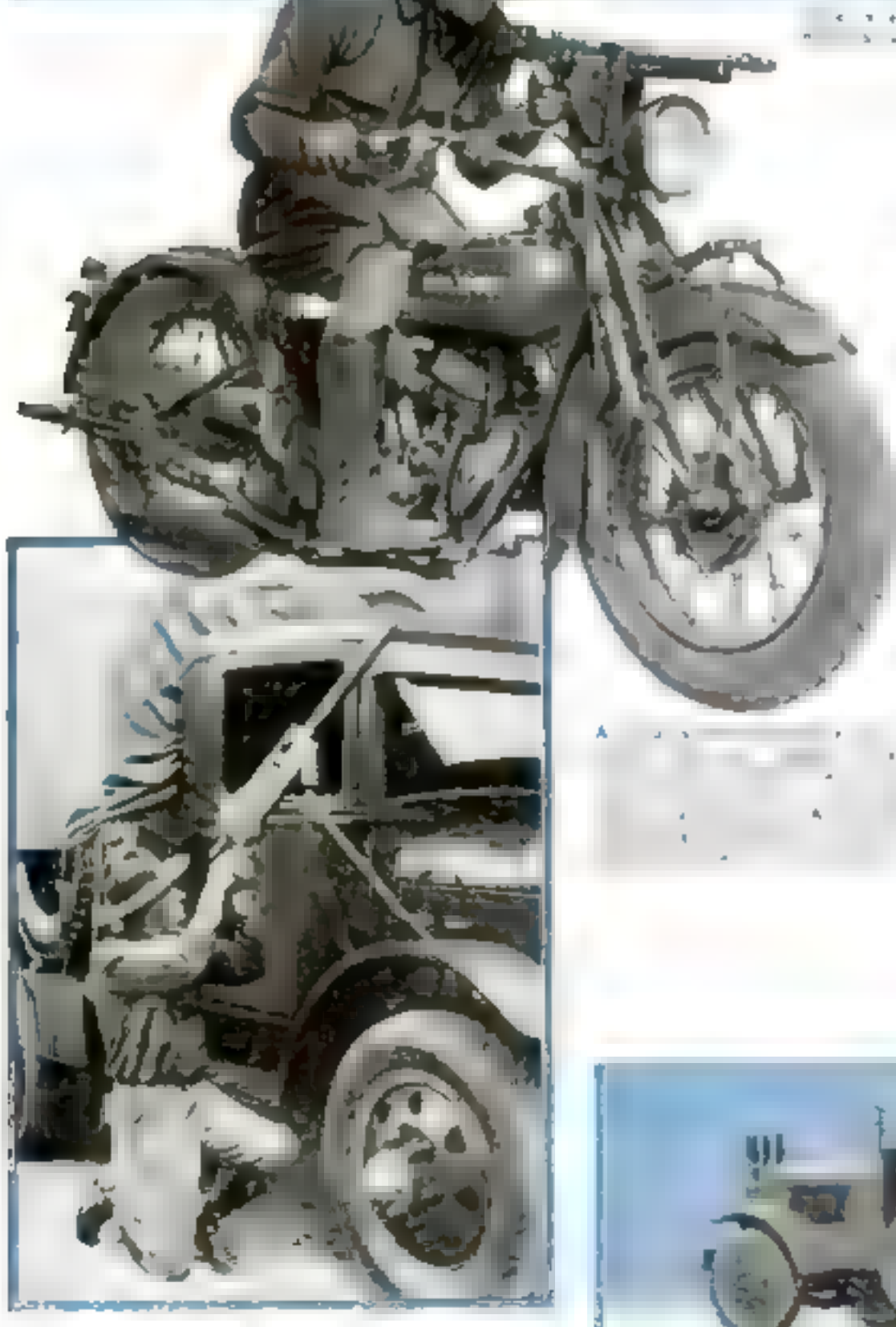
FIVE years ago Arthur Carlson, subway worker of Brooklyn, N. Y., began to clip g articles from POPULAR SCIENCE and other magazines. Now he has a 140-page "encyclopedia" that would of many a scrapbook devotee t hours a day it would take or two he estimates, to read ough A dozen or more complete articles may be placed on one page, by the ingenious method Carlson devised. They are not ssed flat but are neatly hinged edge with gummed tape the clippings overlapping the er By this space-saving system he has managed to cram an enormous amount of information into a single volume Many of the clippings are grouped under special subject headings such as "Astronomy" "Codes" "Police speed." "Time-pieces." and Inventions

SAND BLAST USED TO CLEAN SPARK PLUGS

FOULED spark plugs can now be cleaned by a device that employs a sand blasting process, similar to that which cleans the outside of brick and stone buildings. A used plug is thrust through a rubber gasket in a funnel-shaped receptacle and sand is blown over it by a hissing blast of air, cleaning its points and inner surfaces. Carbon particles removed by this process are blown out through a stovepipelike aperture at the top of the apparatus. It is said that by this system one plug can be cleaned in approximately five seconds

First Mile-a-Minute Army

TAKES FIELD FOR UNCLE SAM



Mighty Guns Wheeled to Front by Gas Power

Hurling itself across the country at four times the speed possible with horses, a new force of 600 men on wheels has been made part of the United States' troops now in Virginia. This swift unit may lead to a vast change in modern warfare.

WONDER PHOTOS REVEAL
UNSUSPECTED FACTS ABOUT

Razor Blades and SHAVING

By
ROBERT E. MARTIN

A THIN ribbon of sheet steel that would reach halfway round the earth is used every year to scrape the whiskers off the American chin.

These unwanted stubs of hair, if laid end to end, probably would reach from here to Mars, but there is no way of estimating the total amount of suffering and mental anguish involved in their removal. It is a safe guess, however, that the aggregate pain produced by dull razor blades exceeds that of all other pain sources put together.

Yet in spite of all the misery caused by razor blades so dull that they nearly pull the hairs out by roots, it is only now that a Washington expert, as a result of an investigation undertaken for POPULAR SCIENCE MONTHLY, is able to reveal, in a marvelous series of photomicrographs just what a razor edge actually looks like when it is sharp, or dull, and what stropping actually does to the cutting edge.

Of course many attempts have been made to photograph razor blades. Most of these pictures have, however, been taken with a magnification of only a few hundred diameters and the true cutting edge has escaped the camera. The problem is much like trying to shoot an elephant and a flea in the same picture. If the elephant shows, the flea is lost and if by increasing the magnification, the flea is disclosed, then the elephant drops out of the picture.

POPULAR SCIENCE MONTHLY asked J. G. Pratt, expert microscopist and photomicrographer of the United States Bureau of Entomology, to make a set of photomicrographs that would tell the real story of a razor blade. The job took several months and required the making of hundreds of experimental photographs and an unforeseen investigation by Pratt of the peculiarities of steel.

AT THE start the obstacles confronting the photographer seemed almost unsurmountable. For instance, it took several days experimentation to relocate under the microscope a section of the razor blade that had been previously photographed. Rephotographing the same section of blade was, of course, vitally necessary to show how the edge was affected by use, stropping, and corrosion.

You probably have heard that a razor removes your beard by virtue of its "saw tooth edge," and you have undoubtedly seen photomicrographs in which the "saw tooth edge" of razors apparently was plainly visible.

Pratt's investigation proves definitely that the "saw tooth edge" is a myth, an optical illusion. What appear to be saw teeth actually are lights and shadows upon the coarse grinding just below the actual cutting edge, in photographs of a magnification of only two to three hundred diameters—insufficient to show the true cutting edges.

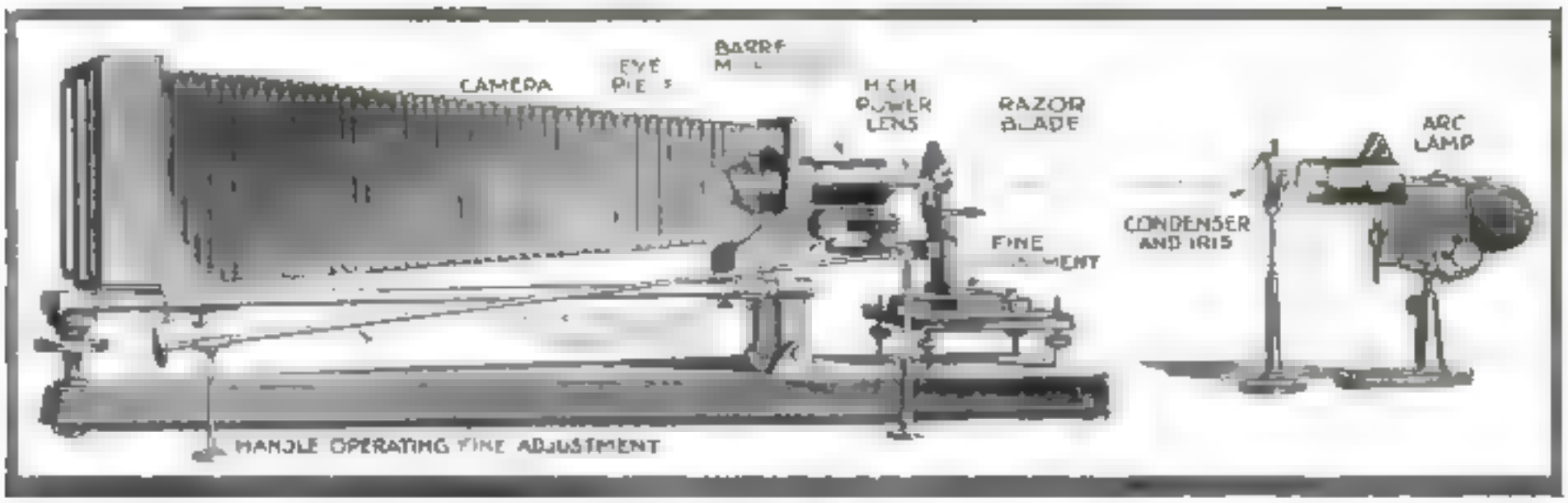
The upper blade of these two has been used four times to shave with, but between shaves it was dried and covered with vaseline. The other picture shows a blade also used four times, but as it was merely dried and not greased, rust has ruined its edge.

When Pratt increased the magnification to 1,000 diameters the "saw tooth edge" straightened out into an unbroken line and at 3,000 diameters the grain of the steel was visible, as were also variations in the edge caused by the texture of the steel and the processes employed in grinding and sharpening.

EVERYBODY knows that stropping a razor makes it shave better but nobody, not even the steel experts, seemed to know just what stropping actually did to the blade edge. That probably is not surprising when until now nobody knew what the edge of a blade looked like.

The theory always had been that the tiny "saw teeth" were bent out of line when the razor was used and that stropping merely bent the teeth back into line again. It was also believed that only razors made out of certain kinds of steel and manufactured in a certain manner could be sharpened by stropping. A widespread impression exists that stropping is useless and ineffective as applied to the wafer-thin blades used in many types of safety razors.

The photographs on these pages clearly show how erroneous these beliefs have been. They show, for example, how the



The above diagram shows the method and apparatus used in making the photomicrographs, which give you the facts about the razor.

cutting edge, originally a wavy line not at all saw tooth in character, is bent over by contact with whisker stubble. The steel fibers are both bent over and crushed backward.

At the bottom of this page are pictures of a blade that has been broken down by shaving off a tough beard four times in succession. Note how, in addition to the usual bending and crushing of the edge, a deep nick has been produced by the actual breaking away of a portion of the edge fibers. The effect of stropping this blade is easily seen. Not only has the edge been restored to original smooth shaving condition, but the size of the nick has been reduced to one third of its original area and the bottom of the nick has, moreover, been formed into a sharp cutting edge so that a hair end that happened to drop into this nick would be parted just as cleanly as those encountering the unbroken line of the cutting edge.

IT HAS long been known that corrosion which in this case means rusting, does more damage to a razor blade than [illegible] shaving. One of the pictures on page [illegible] shows a new safety razor blade cleaned of oil and left on a shelf in the bathroom for ten days. One look at the edge is enough to tell you that shaving with it would be a kind of major operation both painful and ineffective.

The series of photomicrographs reproduced here, many of them made at the enormous magnification of 3,000 diameters but all shown at a 2,000 magnification settles most of the problems that have bothered shavers since the day when a cutting edge was substituted for yanking whiskers out by the roots. The original Americans, the Indians, accomplished the removal of whiskers by plucking them out, one by one, with the aid of the sharp edges of a pair of clam shells that were used as a pair of pincers.

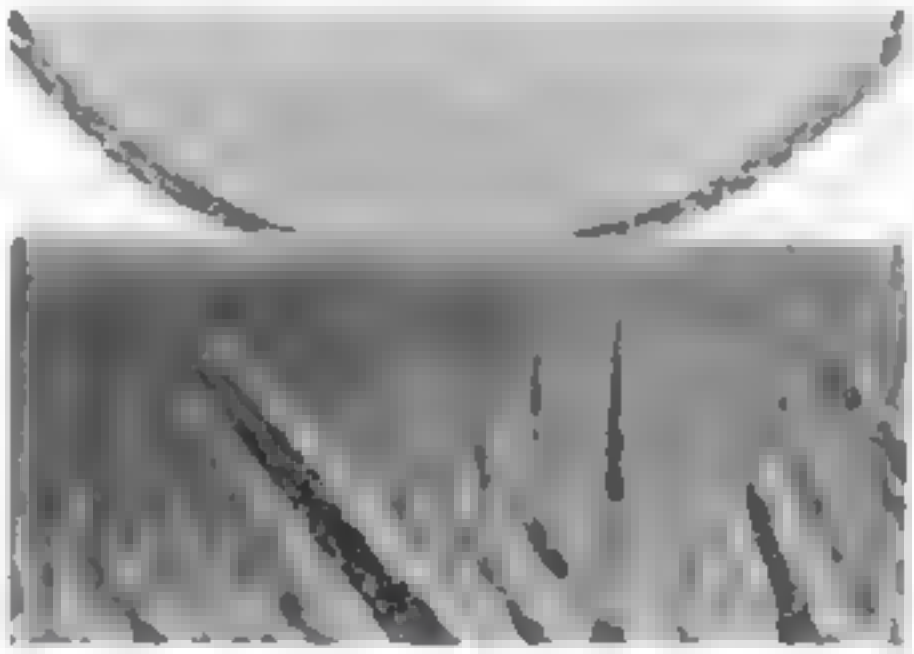
That was a painful process but probably not much worse than shaving after the modern manner with a dull jagged-edged razor. Most of the discomfort of shaving is, as this investigation proves due to the bending back of the blade's sharp edge through use, or the partial destruction of the edge by rust. The jagged edge of a used razor as seen at 2,000 diameters has little to do with the sharpness of the blade. If properly stropped, the bottom of the average tiny nick is still sharp enough to shave cleanly and painlessly such hairs as it encounters.

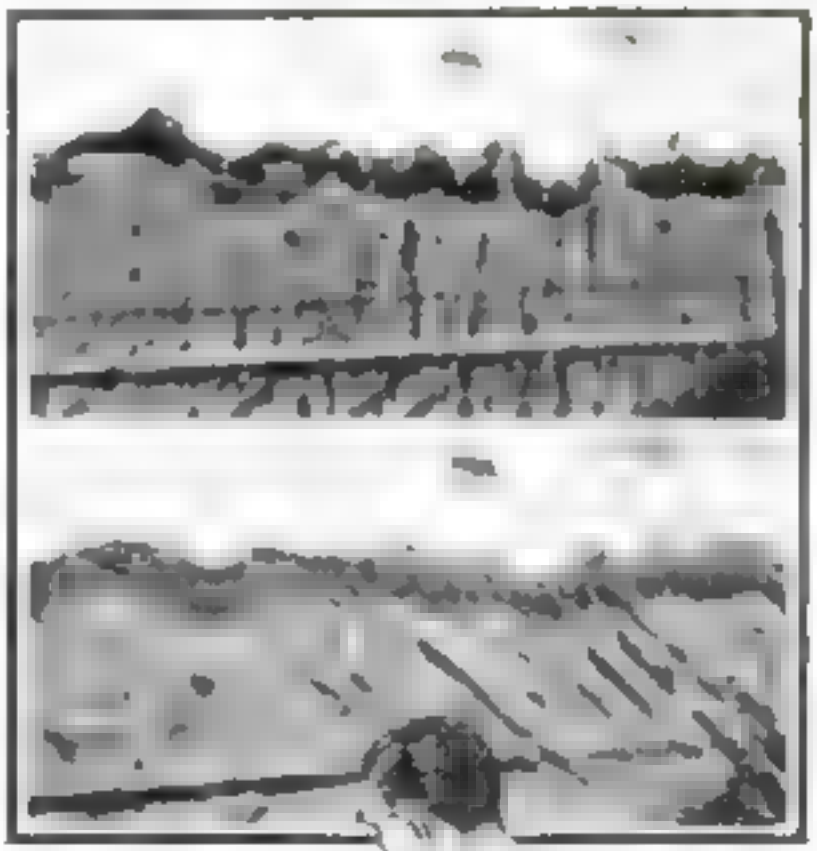
WHAT does stropping actually do to a dull razor blade? This investigation proves that its first action is to bend back into place the fibers of steel that constitute the actual cutting edge. It removes the rust formed on the edge and thus restores the blade to shaving usefulness provided the rusting has not gone too far.

The fact that the bottoms of slight nicks are made as sharp as the edge and that the nicks are actually reduced in size proves that stropping has at least a small abrasive action and therefore sharpening effect. This does not mean, however, that prolonged stropping will put an edge on a really dull *(Continued on page 139)*

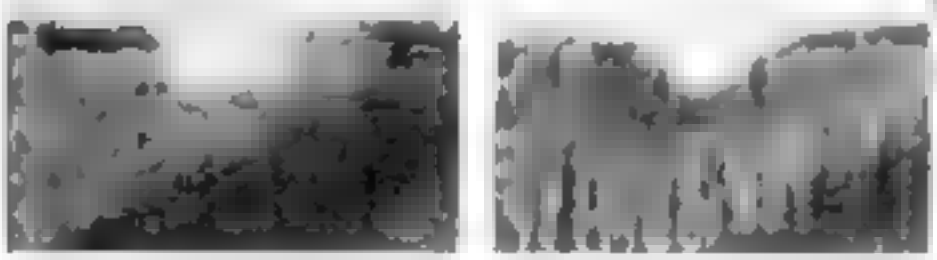
What Is Done by Microscope

At right a section of a razor blade and a drawing of a human hair each magnified 2,000 times. Below the top picture shows how rust has destroyed the blade's edge when razor was left exposed to atmosphere. Beneath it is another view of the blade made ready for use by stropping.

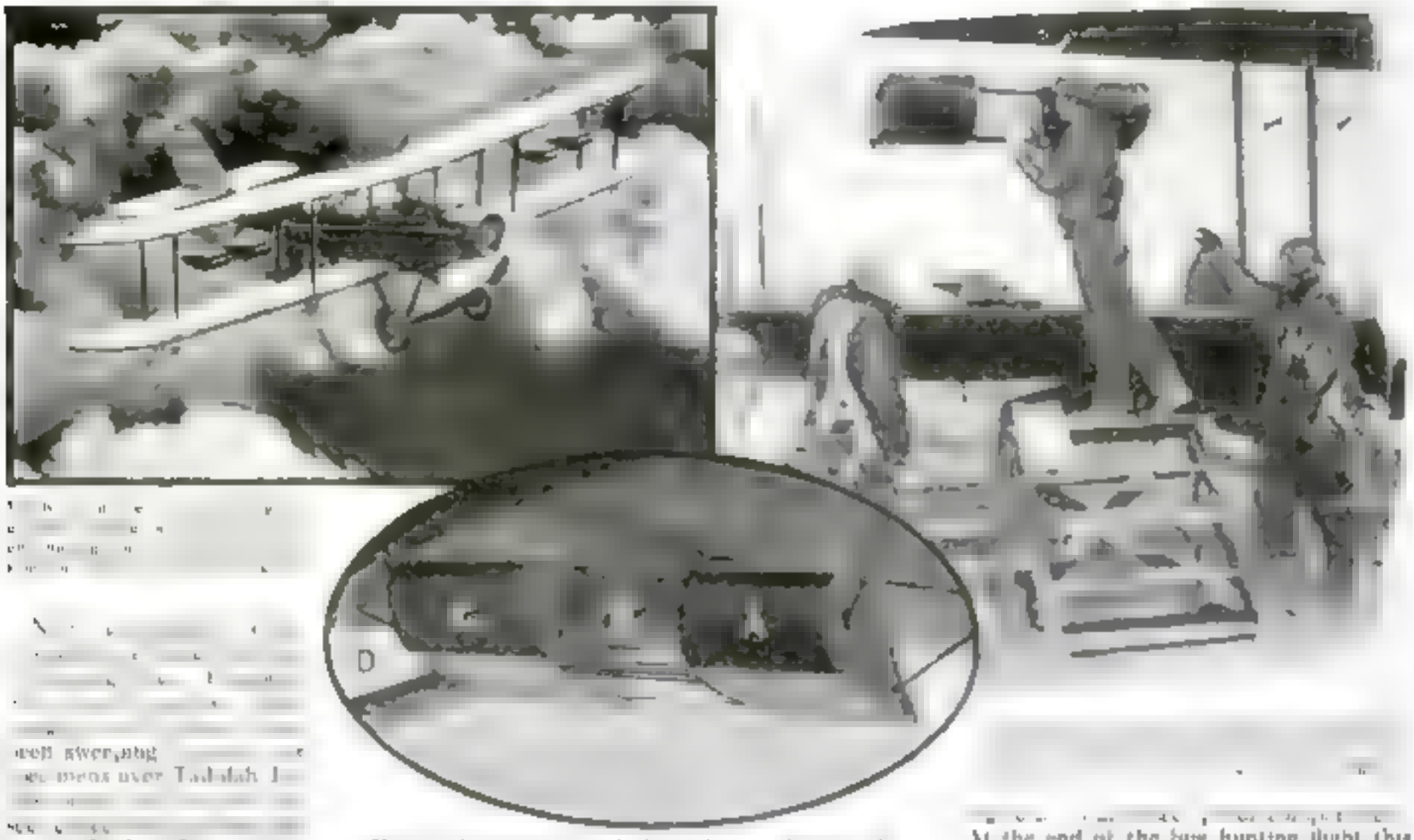




Below, left, note the nick that has been broken in blade's edge and right, see how stropping reduced it



Bug Hunters Use Planes to Trap Insects High in Air



how and why of insect migrations, so that the spread of injurious insects may be controlled or prevented. The number of insects collected at high altitudes, especially the smaller ones is amazing. Balloon spiders which have no power of flight but are borne along by the wind, are found in large numbers two miles above the earth. Other species are obtained at altitudes ranging from fifty to 14,000 feet. Some flights are made at night, to catch insects that are strictly nocturnal in their habits. Rough estimates show the total insect population in the air over a square mile of the area surveyed must be around 25,000,000. Two streamlined insect traps on each plane catch the bugs. Each holds a number of metal screens coated with sticky material. The pilot or observer exposes a screen to the air for a given time at any level by manipulating a wire from the cockpit. Then it is returned, with the insects stuck

Here is the insect trap which can be seen between the wings of the plane in upper right corner. Beyond mesh A hangs ultraviolet screens. At B a screen is put into position to trap the bugs after which it is pushed into the compartment screened C. D is control wire to cockpit.

At the end of the bug hunting flight this screen is removed and the insects examined

BUTTONHOLE MIKE NOW MOVES WITH SPEAKER

A "BUTTONHOLE microphone" now enables a speaker to stroll about a platform as he will while his voice is carried to the audience through the loudspeakers of a public address system. Worn like a gardenia, the instrument is linked by a small trailing wire to the electric system. Even when he is explaining a chart or motion picture film with his back to the audience his voice continues clear and distinct. Previously speakers had to remain within range of a stationary microphone.

NEW KIT HELPS YOU TO ELECTRIFY OLD CLOCK

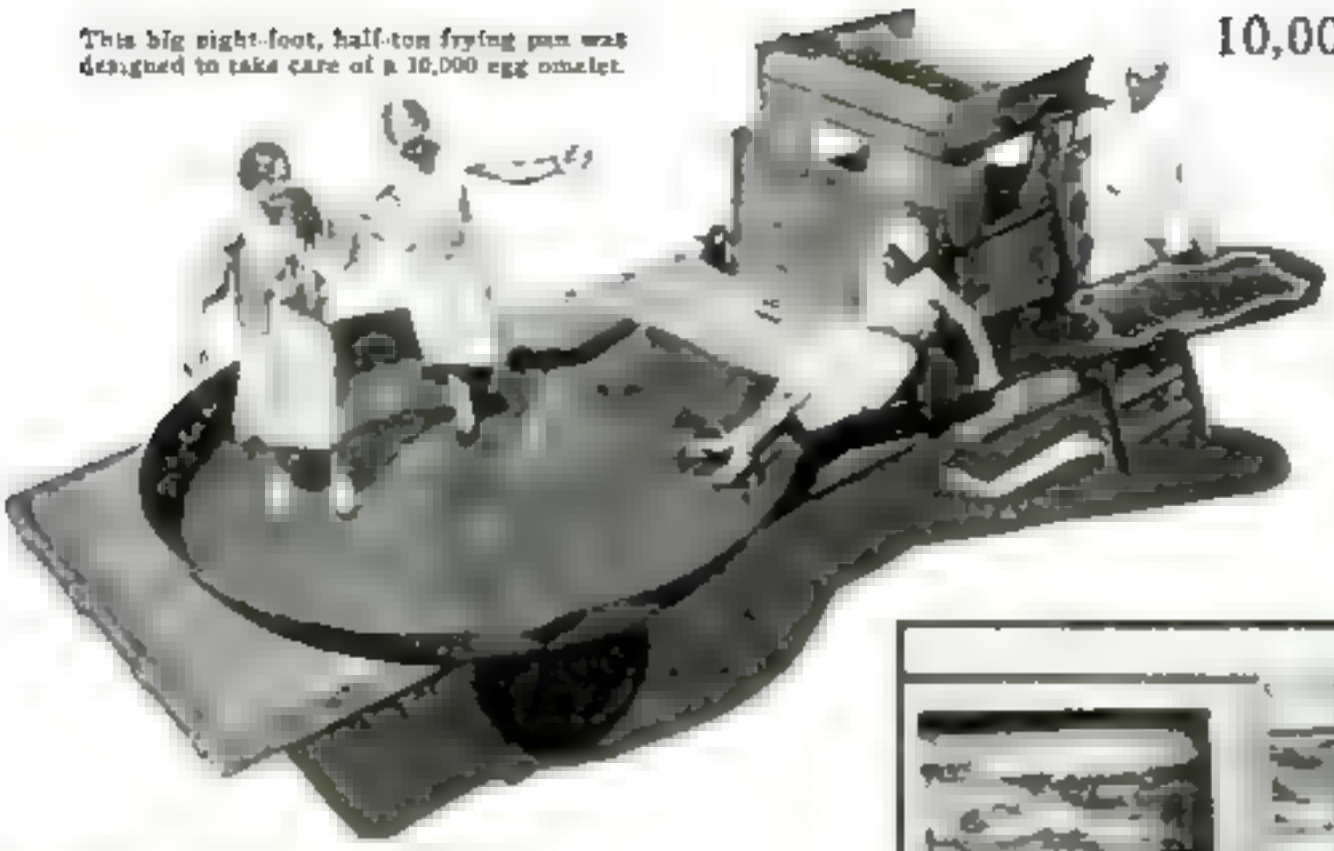
AN OLD clock can be changed into an up-to-date electric model with the aid of a kit recently placed upon the market. Among the parts which the set includes are a special electric clock movement with synchronous motor, and ten feet of cord, five sets of hands for dials from three to nine and a half inches in diameter. According to instructions accompanying the kit, the first step is the removal of the old clock movement and the insertion of mounting brackets. Hands are then added and plugs cover the old winding holes. The clock is then ready to run from the light socket.

ELECTRIC GUIDE AIDS LONDON VISITOR

AN AUTOMATIC electric guide shows strangers how to reach any part of London, England, by street car. Beside a huge wall map of London at the Westminster station, banks of push buttons are arranged opposite names of different points about the city. Pressing a button shows the traveler the number of the car or train that will take him to that point and how much the fare will be. London policemen are said to approve highly of this device which answers questions.

Pressing a button on this electric board tells a stranger in London what street car to take to any desired destination.

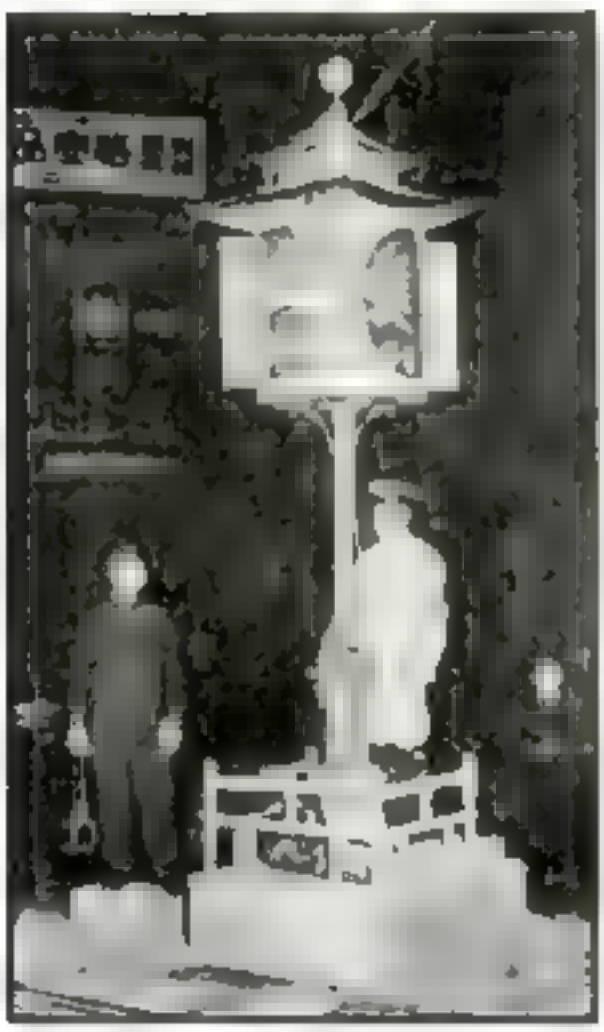
This big eight-foot, half-ton frying pan was designed to take care of a 10,000 egg omelet.



10,000 EGGS IN OMELET

WHAT does it take to cook an omelet containing 10,000 eggs? That was the question that poultrymen of Seattle, Wash., faced, when the event was assigned a place on the program of their annual egg festival. A Seattle stove company solved the problem which was becoming embarrassing, by producing this giant eight-foot frying pan. It weighed nearly half a ton, and a heavy motor truck transported it to the outing where a dozen cooks were kept busy breaking the 10,000 eggs into the capacious skillet and stirring them with shovels.

English soldiers, right, are being trained as marksmen by shooting at animated figures that move along the bottom of picture frame.



SOLDIERS SHOOT ANIMATED PICTURES

ANIMATED paintings in steel picture frames are now being used to train British troops in marksmanship. Miniature soldiers, representing an enemy army, move along the bottom of the frame and up an incline across the picture, while sharpshooters try to pick them off. For this form of practice the distance from the target is only a few paces, making a spacious rifle range unnecessary. As the speed of the moving figures can be mechanically controlled, it is easy to test the skill of the marksmen by hurrying up the targets while the sharpshooters are at practice.

JAPAN HAS NEW STOP-GO SIGNS

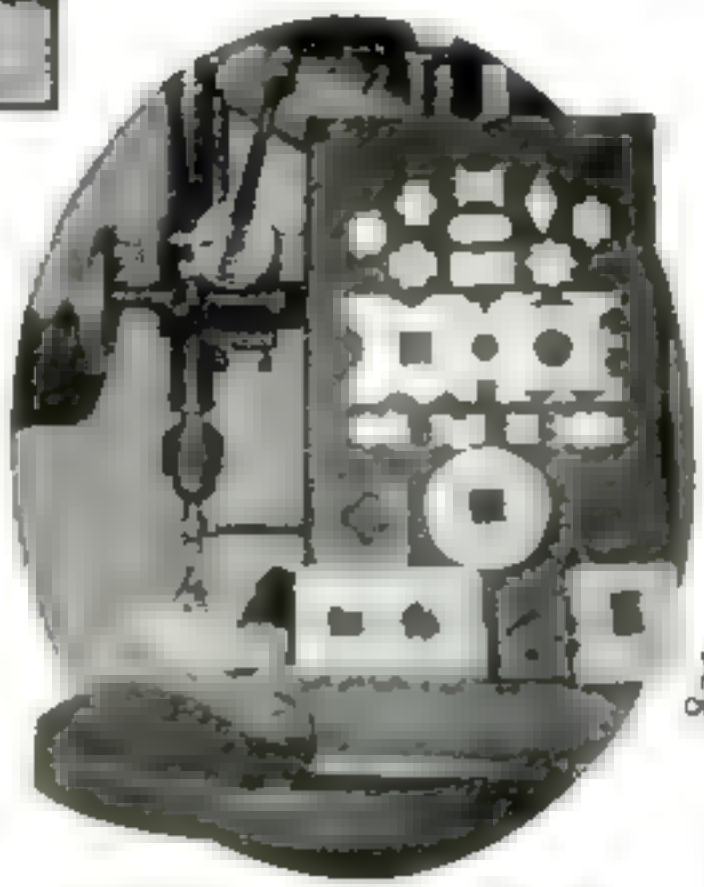
JAPANESE characters tell the motorist when to stop or go in Tokyo's newest traffic signal. Lest their meaning should be lost upon American or English drivers, however, the words are repeated below in English. Numbers of these picturesque control signals with pagoda-like roofs are now being erected on the busiest streets.

MOVIE ON CLOUDS

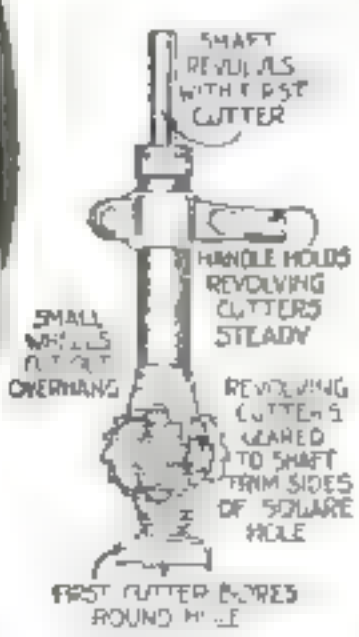
SOON Berlin crowds may see movies upon the clouds at night. Dr Manfred Mannheimer, German inventor, is perfecting a huge projector capable of throwing an animated cartoon film upon a low cloud bank. Cartoons would be stenciled upon a film of metal.

THIS BIT BORES A SQUARE HOLE

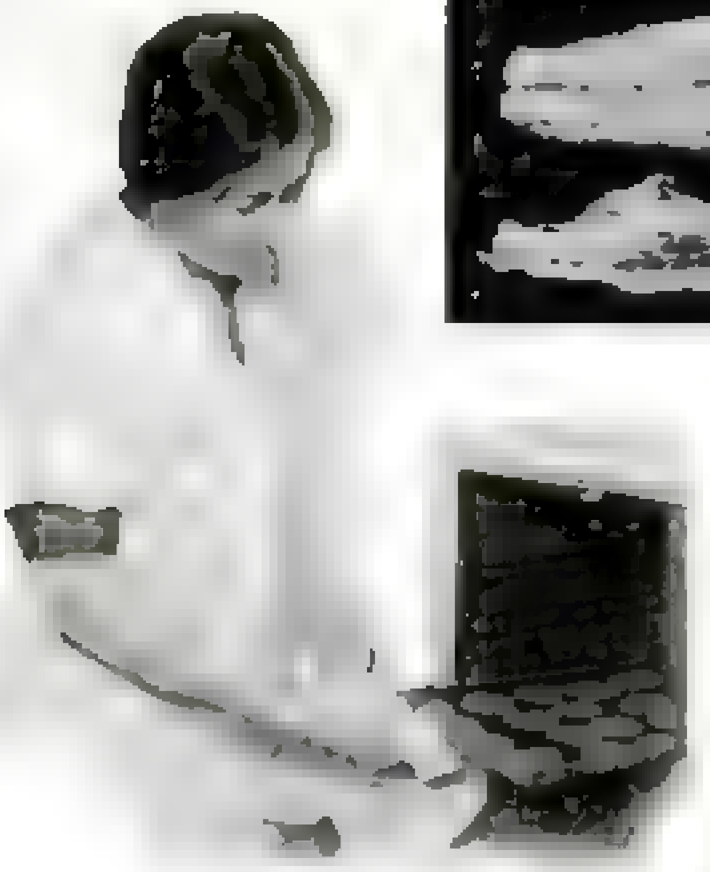
A BIT that bores square holes is the remarkable tool devised by a Peoria, Ill., mechanical engineer. It makes comparatively easy certain types of boring and milling work that have hitherto been considered impossible, according to its inventor. Star shaped holes may also be bored and one of the instrument's most striking accomplishments is the boring of a spiral hole. The new drill is used in the same way as an ordinary twist drill, and may be taken out on the job and employed as a portable electric tool. Its secret is a set of revolving cutters mounted around the sides of the shank, which is held stationary or revolved by hand through a right-angle grip. Any material, such as wood, stone or steel, may be bored with this very unusual tool.

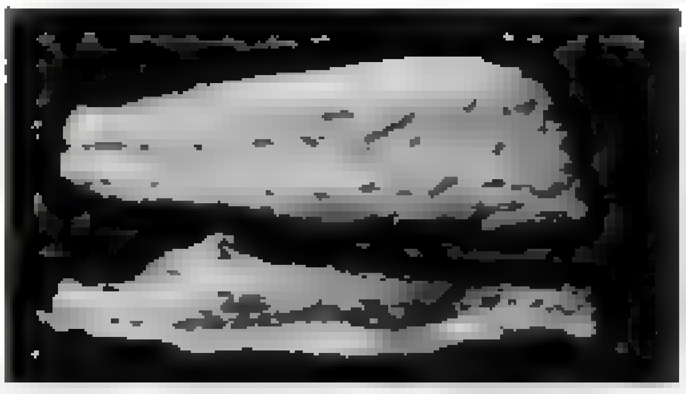


Above, square and odd-shaped holes cut by a new drill. At right, diagram shows how it works.



FISH FLOUR DIET GETS ITS FIRST TEST





Above: backbone and flesh of fish from which fish flour is made. [illegible]

Tests of fish flour, a new food high in mineral content, obtained as a by-product of the packaged fish industry, are now in progress at a public institution in Washington, D. C. Here eighty children have been selected for the first large-scale test of the food under Government supervision, to determine its value. The experiment is expected [illegible]. The subjects [illegible] s discussed in such [illegible] con- [illegible] een [illegible] Three [illegible] cord- [illegible] make [illegible] in building children's teeth in the human diet. The District of Columbia Dental Committee is interested in the tests, and has appointed a special committee to observe any benefits which children may derive from the new food. Despite its source, fish flour as used in partial substitution for ordinary flour, is said to be entirely palatable.

MEASURE TORN MONEY TO GAGE ITS VALUE

When is torn money good money? Banks answer the question with the transparent scale of mica shown in use in the illustration above. A damaged bill is considered to have full value if it measures more than three-fifths of its original size. Even if only two-fifths of the original bill remains, the bank nevertheless accords it half of its face value.

TURNS FORD INTO A MOTOR PLOW

A new use for the old flivver was discovered recently by Archie Woodland, Indiana farmer. He mounted the front of the car on a brace from an old horse cultivator, put disks under the chassis for plowing corn, and placed tractor-type wheels in the rear with a chain drive from the rear axle. To augment the cooling system, a five-gallon can of water was connected to the top of the radiator.

PICTORIAL SIGN HELPS TRAVELER IN GERMANY

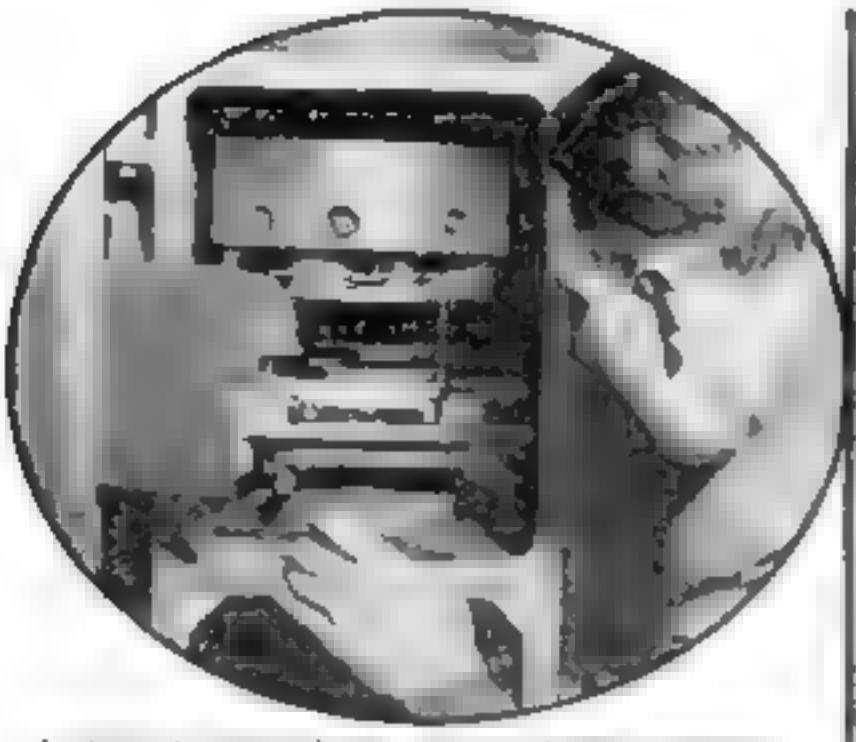
Thanks to its combination of art and humor, even a tourist unfamiliar with the language, understands an ingenious German signpost, which was erected recently near a railway terminal in that country. Hand-carved, bright-colored figures supplement legends below which read when translated "To the station."

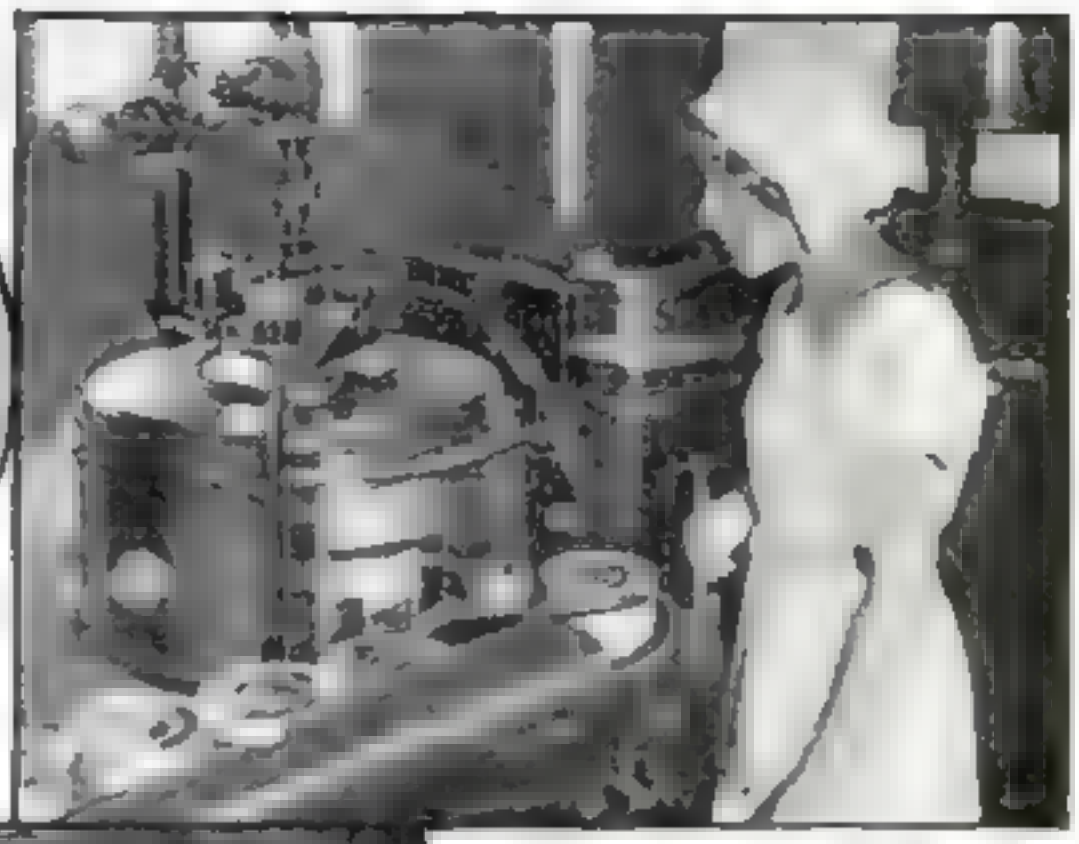
MINIATURE RACE TRACK BUILT FOR CHILDREN

To keep his children from playing in the street, where passing automobiles endangered them, a Kansas City, Kans., home owner had a miniature racetrack built in his backyard. Now the young ones of the family race merrily around the 200-foot oval on tricycles, roller skates and bicycles just as if they were on a real race course. The concrete strip is three feet wide, encircling a large play house built for the children at the center, and the curves are banked for speed. According to Clay Roberts, owner of the house, any sidewalk contractor can build such a play track the cost of which is relatively low and thus provide his children with a safe means of amusement.

This miniature race track, encircling a play house, was built by a Kansas City resident to keep his children from playing in the street. Curves are banked so continuous high speed is possible.

New Process Keeps Coffee Fresh in High Vacuum Cans



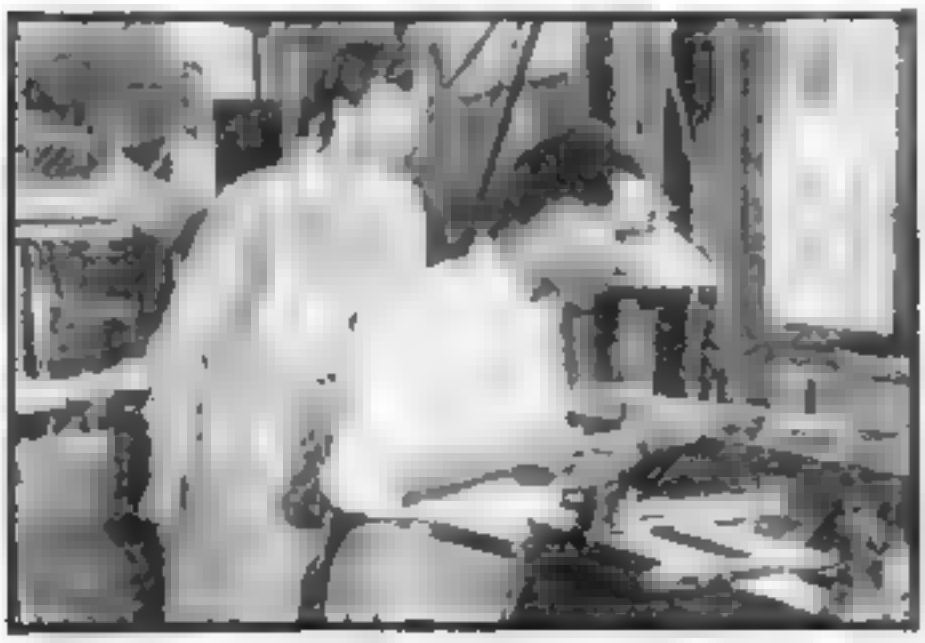


me bod remain indefinitely upon a
vacuum ever obtained commercially
removed before the can is sealed as
percent. The new process is now being used by a manufacturer of a well-known brand of coffee. Air is coffee's arch enemy. Exposed to it the brown grains lose their flavor in two ways. Carbon dioxide gas generated inside the coffee bean by roasting slowly escapes and takes the flavors with it. Then the air's oxygen turns the remaining portion stale through a chemical process known as oxidation. To exclude air vacuum packing is resorted to. In a modern high-speed factory cans full of coffee with their tops loosely in place travel down a conveyor belt. Mechanical hands seize them and thrust them one by one into the vacuum chamber. A hiss, and the air in the can is sucked out by an air pump. Before the can leaves the chamber, powerful metal rolls crimp the top into an air-tight joint. Hitherto it was thought that only ninety percent

required to take out an additional nin
ma hine that takes out the air in several
which some air is extracted, before they go into the highest-vacuum chamber where they are sealed. The high efficiency of this machine makes it possible to use air pumps of moderate capacity at low cost. Engineers foresee that the super-vacuum process may be applied to other things besides coffee. Meats, shelled nuts and tobacco are among the products which may benefit from the system Rector has developed and which is now in use

NEW YORK'S "FIRST LADY" RUNS FURNITURE FACTORY

The "first lady" of New York State, Mrs. Franklin D. Roosevelt, wife of the Governor, runs a furniture factory of her own when she is not busy presiding as hostess at official parties. Unlike many hobbies this one of Mrs. Roosevelt's is said to be a paying business. The factory, an attractive three-story frame structure, is hidden behind trees and shrubbery on Mrs. Roosevelt's Hyde Park, N. Y., estate. Here a corps of competent craftsmen execute designs under Mrs. Roosevelt's supervision. Her home is furnished with some of the products of the factory, and others find a ready public market. Mrs. Roosevelt visits the factory when possible.

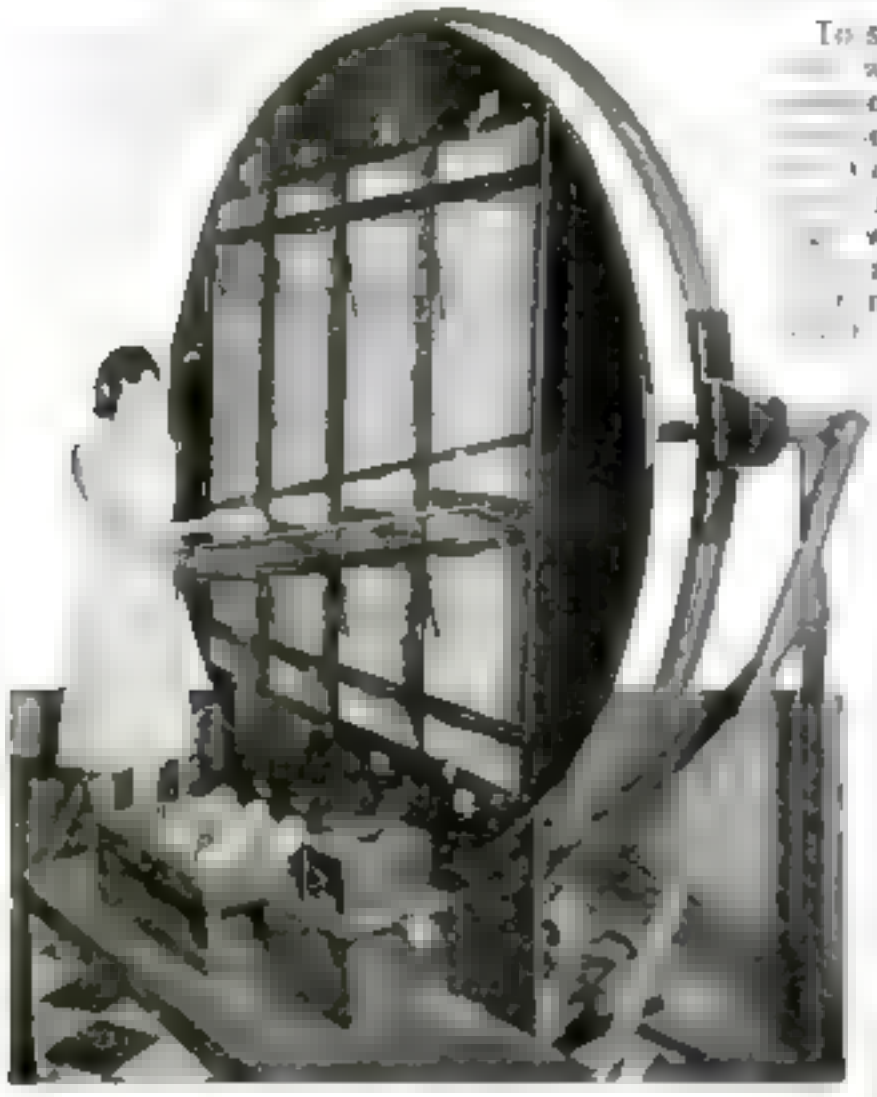


Mrs. Franklin D. Roosevelt, wife of New York's governor, inspects the work in her furniture factory at Hyde Park, N. Y.

MAKE "COONSKIN" COATS FROM COYOTES

The coyote of the western plains, long considered vermin by cattlemen and ranchers, at last has found a useful niche in life. It supplies many of the "racoon" coats worn by college students during the fall and winter. This surprising fact came to light when the American Society of Mammalogists recently condemned attempts at wholesale extermination of any species, coyotes included. In spite of the ruthless war carried on against them, coyotes breed rapidly, and are found in large numbers all the way from the City of Mexico northward into Alberta, Canada. Thus there is a certain supply of pelts.

TEST LIGHT BULBS BY BUMPING THEM



Electric lamp bulbs are put into this machine which revolves and drops them to see if they can sustain hard usage

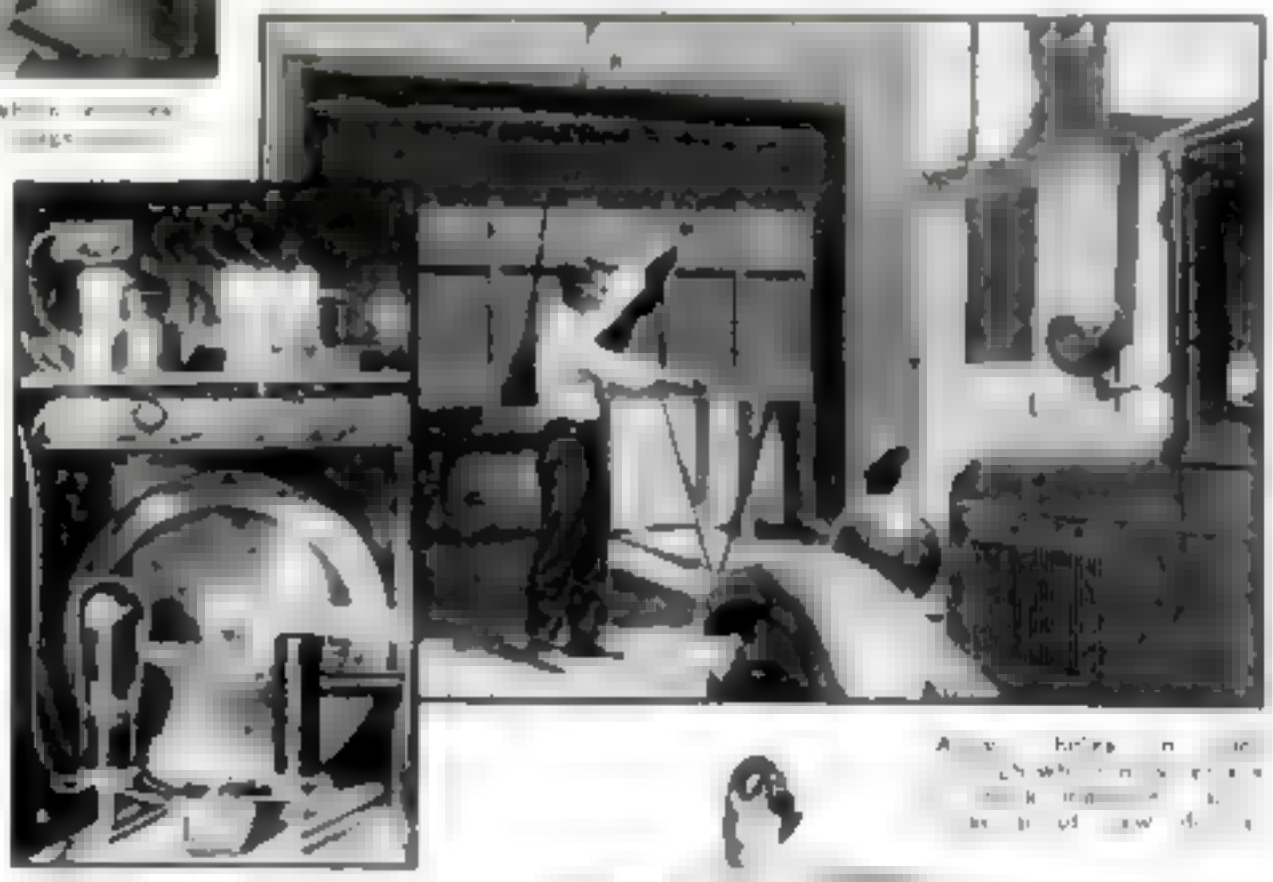
To show whether lamp bulbs withstand the rigors of ortation and mishandling ow undergo a "bump test" eveland, Ohio, factory A machine with a squirrel-wheel, divided into eight artments, applies the nical third-degree. As the revolves, shelves on the side of each compartment allow lamps to fall a predetermined distance which increases from the first to the eighth compartment. A lamp under test gets ten bumps in each compartment being examined between the bumps for broken internal parts. A certain percentage of all manufactured lamps, selected at random, take the test to insure the high quality of the marketed bulbs before they are permitted to leave the factory.

NEW HAND MIRROR HAS BUILT-IN FLASHLIGHT

EVEN in the dark, a woman may apply powder or make-up with the aid of a new kind of mirror that contains a built-in flashlight. Its light streams through a round hole at the side of the mirror and illuminates the user's face. Recently introduced in London, the combined mirror and light is intended especially for motorists and theater goers.

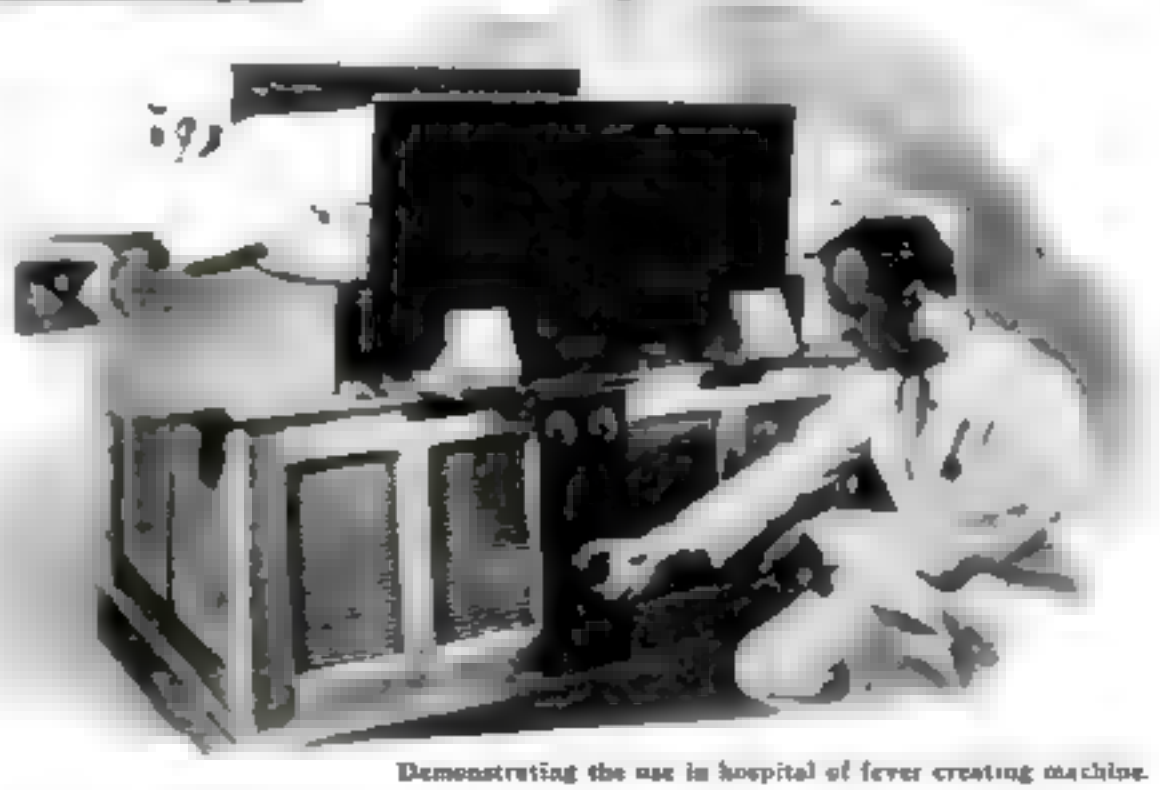
HORN OR HEADLIGHT OPENS GARAGE DOOR

Toot your car's horn, if it is daylight, or flash on the bright lights if it is dark, and your garage door will open automatically for you, if it is equipped with a device invented by two Los Angeles men. The brains of the device is a small electric box mounted behind one of the doors. Sound waves from the horn enter through a hole in the door, and actuate a mica diaphragm in the box, closing a contact that sets the door-opening mechanism in action. This apparatus is also turned on when a beam of light from the auto headlight enters another hole and falls upon a photo-electric cell in the same box, closing a relay that works the door-opener



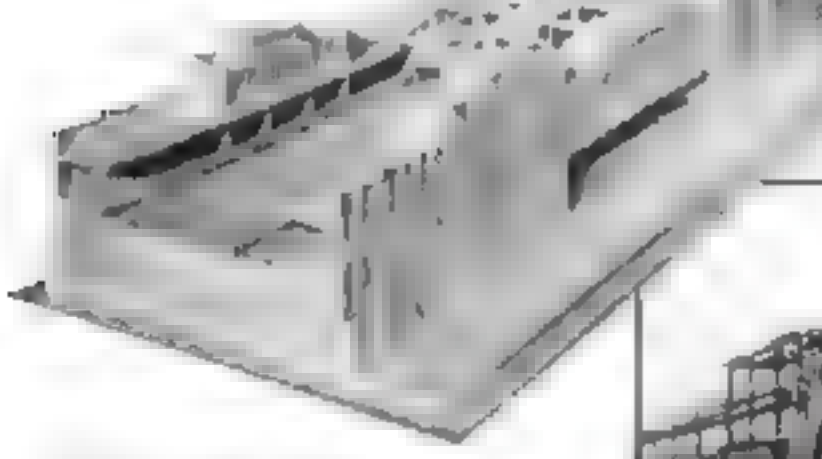
FEVER MACHINE NOW USED IN HOSPITAL

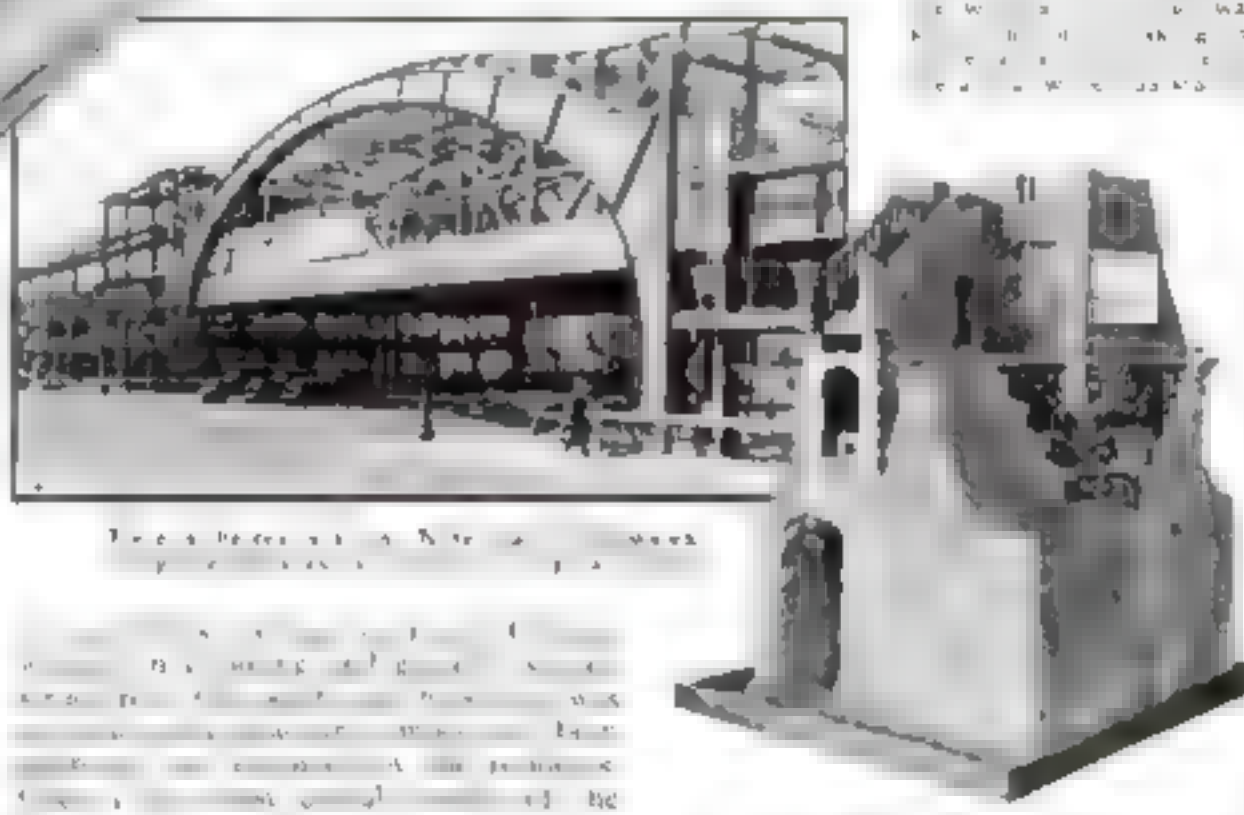
TESTED and approved by medical men the first "radio fever" machine to go into actual use was recently installed at the Fifth Avenue Hospital, New York City. It is expected to be of benefit in treating cases of arthritis, rheumatism and diabetes. As told at the time of its invention (P S M., Aug., '30, p. 32), the machine produces an artificial fever in a patient by heating his blood with high-frequency radio waves. This is beneficial in some diseases. The effect was discovered accidentally at the General Electric laboratories in Schenectady, N. Y. where research workers near a high-power short-wave tube were stricken with fever. In the medical device the patient lies between two black plates that serve as antennae for the radio waves.



Demonstrating the use in hospital of fever creating machine.

America's Newest Subway Built First in Perfect Models





By means of this model property owners were shown just how the subway would be built without interfering with the safety of buildings near it and all trouble was avoided.

and ticket agents. Several changes were made in plans for the station after engineers examined the model, including the altering of two entrances and a ramp to a lower level. Prospective tenants rented booths on the concourse, picking their locations from the model. In passing through Brooklyn, N. Y., it was necessary for the subway to rise out of the ground

Board of Transportation quieted the nerves of anxious property owners. When it proved necessary to run the subway beneath or near a building the model illustrated just how the engineers would install underpinning to brace the structure during construction or build new foundations where necessary. Thus owners of buildings were convinced that nothing would be disturbed and no damage would result to their property during the building of the subway. In this manner suits were avoided by use of the model.

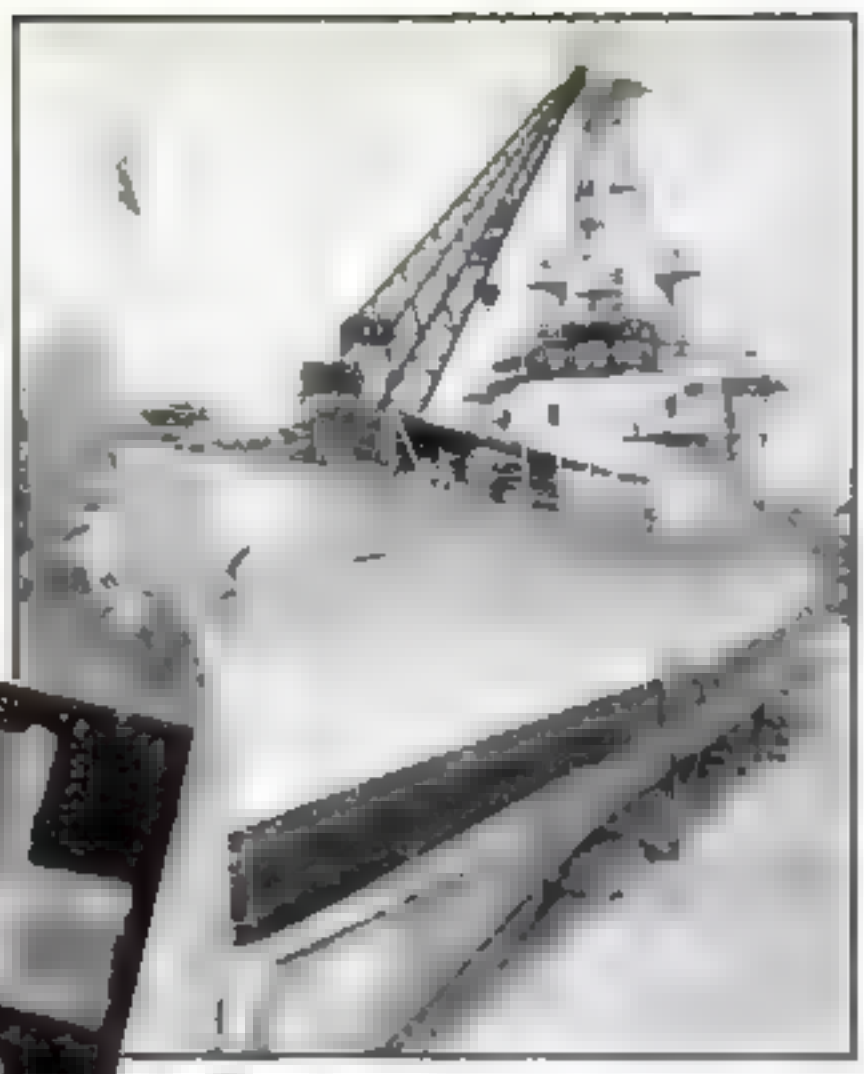
BATTLESHIP OUTLINED WITH LIGHTS

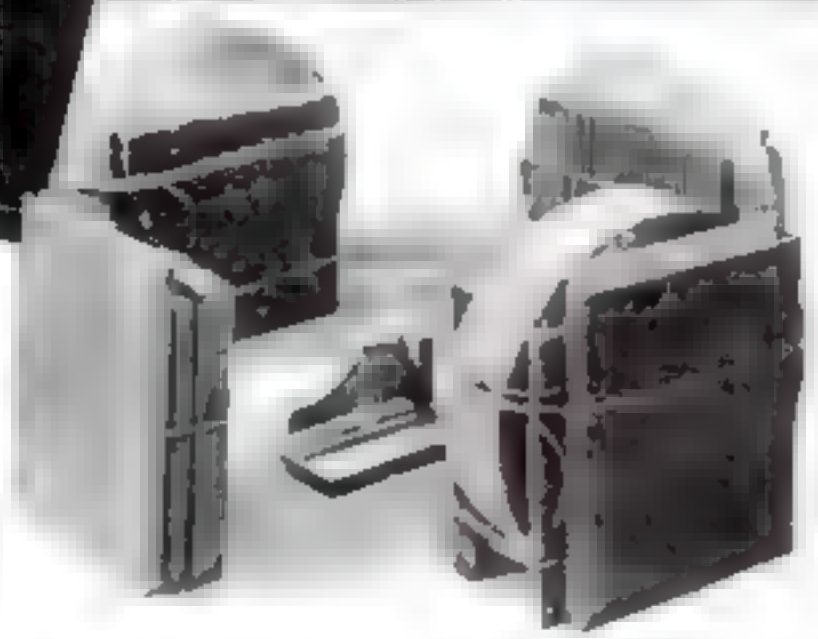
More like a barge festooned with lights to grace a pageant than a grim man-of-war appeared the U. S. S. *Nevada* as she lay at anchor off Newport Beach, Calif., the other day. A hundred thousand spectators lined the cliffs and shore to see the unusual spectacle during a "tournament of lights." Powerful incandescent lamps outlined the battleship's decks while her lights swept the sky

SIGHT BAR ON PUTTER MAY AID THE GOLFER

WITH a new sight clipped to his putter, a golfer may aim a ball accurately on a long shot for the hole. The straight bar shows exactly the direction in which it will go, and only a poor eye or an uneven green can be the excuse for missing the objective. Since the sight is mounted on the top of the club's head, it does not interfere in any way with striking the ball. The device is intended for use in practice.

Radium Finds Flaws in U. S. Cruisers





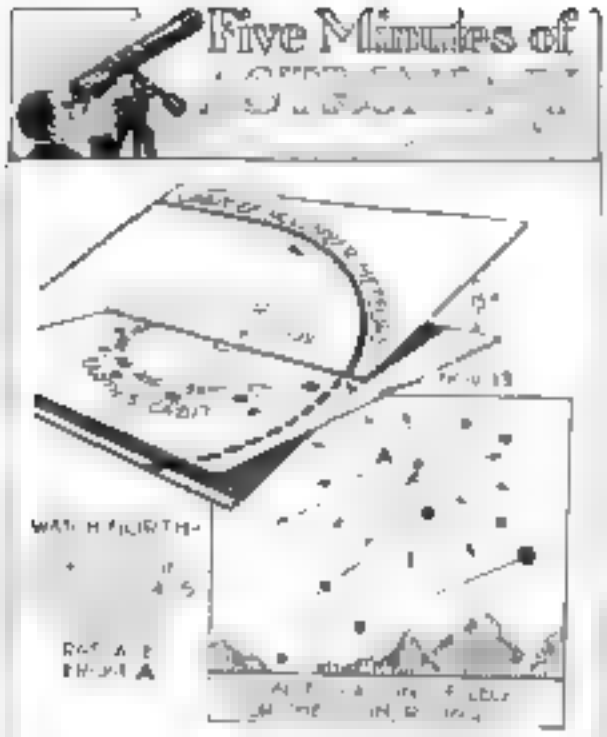
Navy ... of radium to avert a repetition of costly defects found recently in some of its prized 10,000-ton treaty cruisers. At a cost of $4,000 the Navy has just purchased four tiny capsules of radium and sent them to Navy yards ... and Pacific coast. H... to test all vital castings ... rate labor. This i... application of a pro... last fall in wh... radium replaces a bu... king X-ray p... Dr. Robert J. M... Research Laboratory Wa... says that radium's penetrating rays will pierce ten inches of steel and give photographs that plainly show any cracks it may contain. Ordinary X-rays cannot be used in practice for examining pieces more than four inches thick. The new process, therefore, makes it possible for the first time to examine huge castings

A ... holding the container of radium is placed on one side of the casting, and a standard X-ray film in its sheath on the other. An exposure of several hours gives a perfect internal picture of the casting. The success of this process was demonstrated when experts sought to find why the stern post castings of five of the Navy's eight new ... nary X-ray methods. Photographs taken by the new radium process, with radium borrowed from Johns Hopkins University, plainly showed the internal cracks that were to blame. Had the castings been inspected with radium before they were installed, the chances are that they would have been rejected and the country would have been spared the expense of putting the ships in dry dock for the costly task of replacing the castings.

Power from fly... wheel of engine ...

MAKES HIS OWN LOBSTER POT LIFTER

A COMFORT-LOVING lobster fisherman of Orrs Island, Maine, no longer hauls up his heavy lobster pots by hand. Recently he fitted the boat in which he makes his rounds with an ingenious mechanical lobster pot lifter, made from the rear end of a discarded automobile. Power taken from the flywheel of the boat's engine is transmitted to the lifter by a belt, as shown in the photograph, and revolves a winch to haul in the pot. The installation cost him less than five dollars, while commercial types of mechanical pot lifters cost from twenty-five to fifty dollars.



WHY SHOOTING STARS FLAME IN NOVEMBER

SHOOTING stars are the shattered remains of broken-down comets. Since a comet travels in a definite orbit round the sun, its millions of disintegrated chips continue to travel the same path through space as a swarm of meteors. Parts of the swarm gradually lag behind the main bunch of comet debris, and in time the orbit of the former comet may be said to resemble a gigantic diamond ring, with the main swarm representing the jewel and its setting, and the widely-strewn stragglers outlining the ring itself. Every year our earth, in following its own orbit, crosses several of these enormous meteor racetracks. At these times, large numbers of the meteors pass rapidly through our atmosphere and are burned up by the resulting friction. One of the most important of these Fourth of July fireworks displays comes about the middle of November, when the earth's path crosses the orbit traveled by the swarm called The Leonids. If two large cards (marked with the orbits, and slotted as shown in the diagram) are held at a slant of about fifteen degrees to each other, they will show how the two paths meet. The number of Leonids seen each November varies considerably. Some are visible each year but every thirty-three years, when the earth meets the gem of the ring there is a particularly brilliant display. Great showers were seen in 1833 and 1866; a much smaller number in 1899. The next event of this kind is due in November 1932. Although the meteors are actually travelling in parallel lines they appear to radiate widely from a small area, just as parallel railroad tracks seem to diverge toward you from a point on the horizon. The Leonids should be watched for on November 14 and several nights preceding and following if the best effects are to be seen.

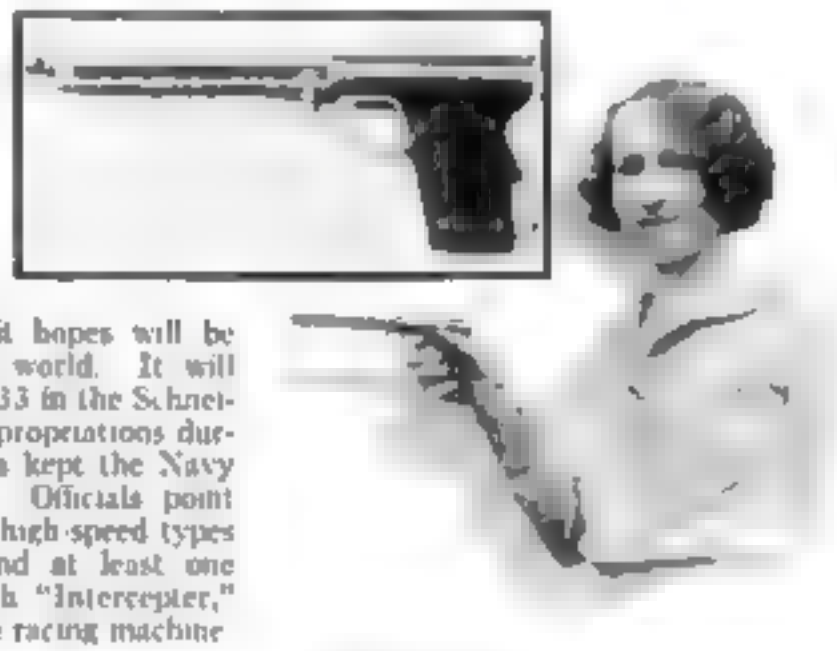
PORTABLE SET RADIOS GOLF MATCH

A NEW portable short-wave transmitter and receiver has been placed in service recently to broadcast radio reports of important golf matches. With this apparatus, the announcer is able to follow the players around the course, a caddy carrying the transmitter strapped to his back. At the completion of a hole, the announcer packs up the microphone and broadcasts the score direct from the green. Because of its special design the new set is able to operate with unusually compact antennae. One of these is a loop; the other forms part of a pole on which the receiver is mounted. The transmitter operates on a short wave that is approximately five meters.

Portable short wave transmitter with loop antenna is shown strapped to caddy's back while announcer reports golf match.

NAVY SEEKS FAST PLANE

WITH $220,000 already appropriated by Congress for the purpose, the U. S. Navy has just signed a secret contract with a civilian designer to build what it hopes will be the fastest plane in the world. It will probably be entered in 1933 in the Schneider cup race. Lack of appropriations during the last five years has kept the Navy out of this competition. Officials point out that it helps develop high-speed types for military purposes, and at least one fighting plane, the British "Interceptor," has used the design of the racing machine.



To protect him from the rain this Japanese farmer has woven a coat of matted straw

PISTOL SQUIRTS LIQUID THAT KILLS FLIES

A TOY-LIKE pistol, shooting liquid insecticide, is designed as a fly exterminator. A fly that is hit, it is said, immediately falls to the floor and dies. Mosquitoes and other insects also succumb to the liquid, which is said not to harm walls or draperies. The gun is cocked by squeezing the handle, and discharges a concentrated spray when the easily operating trigger is pressed.

USES MATTED STRAW TO MAKE RAINCOAT

Though he may never have heard of rubberized raincoats, the Japanese farmer shown in this photograph has improvised a satisfactory substitute. Working in the fields, he is shielded from a downpour by a cloak of matted straw, while for headdress he wears a conical hat woven of the same material which is rain proof.

OIL FIELD REPORTS SENT BY PIGEON

A TEXAS oil man recently solved the problem of getting daily drilling reports from a well being sunk a hundred miles south of San Antonio, and thirty miles from the nearest telephone, by turning to practical use his hobby of raising homing pigeons. A flock of pigeons was taken to the well to bring in reports. Now two birds are released daily, with messages tied to their feet. At the home loft the oil man's twelve-year-old son receives the pigeon two hours after it has left the well. Before the oil operator thus resurrected one of the oldest communication systems known to man, it took the better part of a day for a driller at the well to drive to a telephone, make a report, and get back to his work. With the new system, any workman at the well can release a bird. Other oil companies also may adopt this system to get quick reports and so keep in touch with operations.

Above, carrier pigeon released at oil field with daily report. Left, boy gets message.

LIGHT LADDER MADE OF ALUMINUM

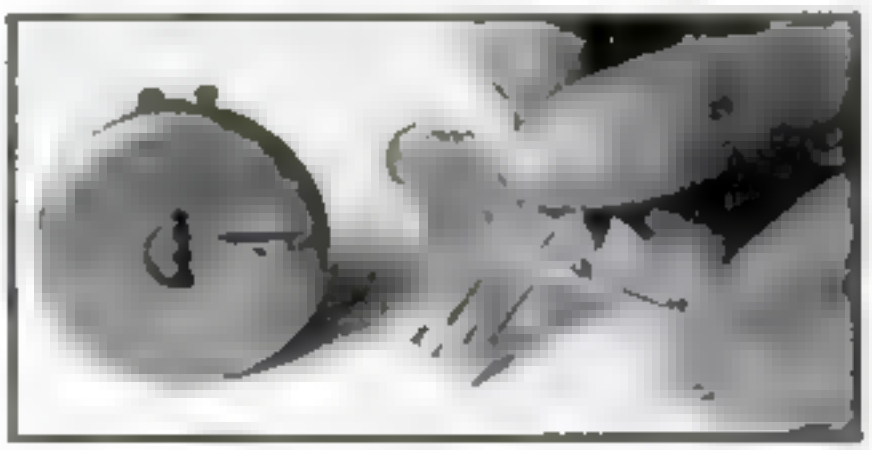
EVEN the frailest housewife would find it no task to take a new featherweight ladder from the closet and set it up for use. It is made of aluminum and the manufacturer says it will support a quarter of a ton with safety. This novelty, exhibited in England at a recent exposition attracted much attention.

ROBOT SELLS CIGARS AND MAKES CHANGE

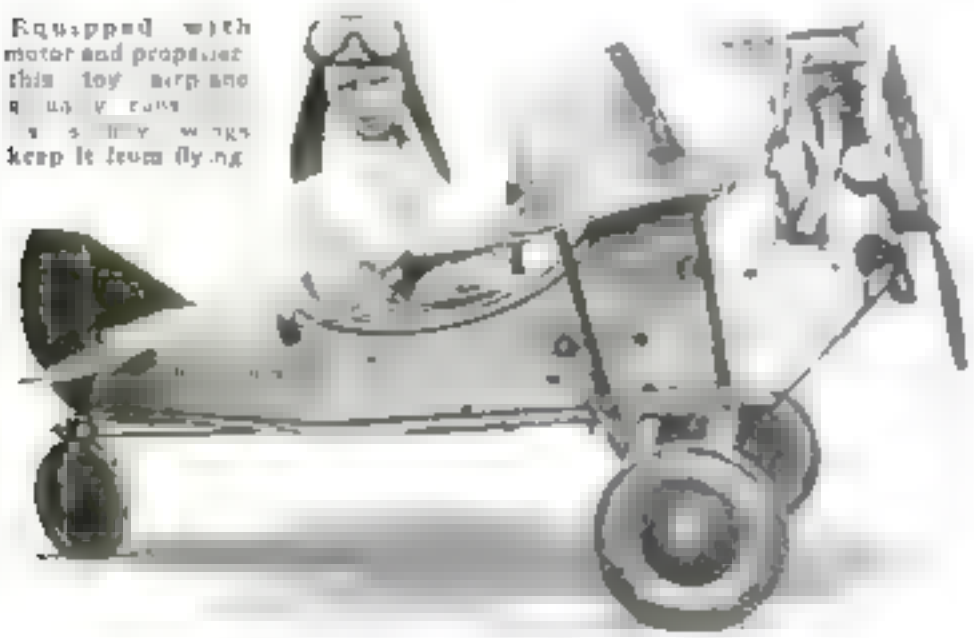
YOUR favorite cigar is handed to you, right out of the original box, by a new automatic machine that is operated by the insertion of a coin. The mechanical salesman makes it unnecessary for a purchaser to wait at a crowded counter, and leaves the clerk free to attend to other business. The device is made in single or multiple units to sell one cigar or a dozen different brands, and each unit is quickly adjusted to respond to a coin of the proper denomination, or, in the case of odd-priced cigars, to make change. Only genuine money is accepted by the robot and change is always correctly made

THIS TOY AIRPLANE DOES EVERYTHING BUT FLY

AT THREE years of age, Sam Swindle of Athens, Ga., is "pilot" of a miniature airplane. It was built for him by his father, a master mechanic. Though its clipped wings make it impossible for it to leave the earth, the tiny machine actually travels along the ground under the power of a small gasoline engine and gives the boy all the thrills of real flying.



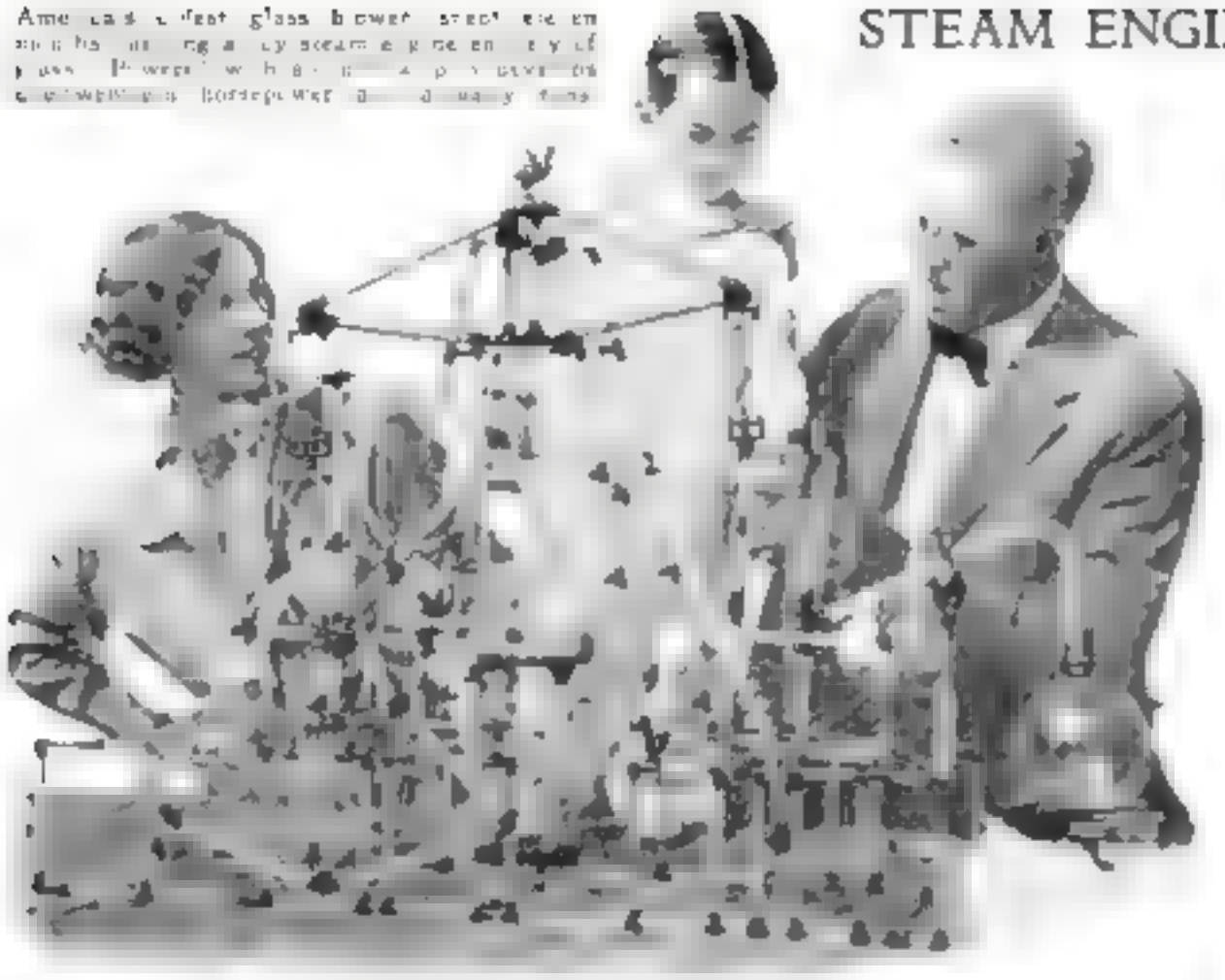
Equipped with motor and propeller this toy airplane runs on the ground, but its clipped wings keep it from flying



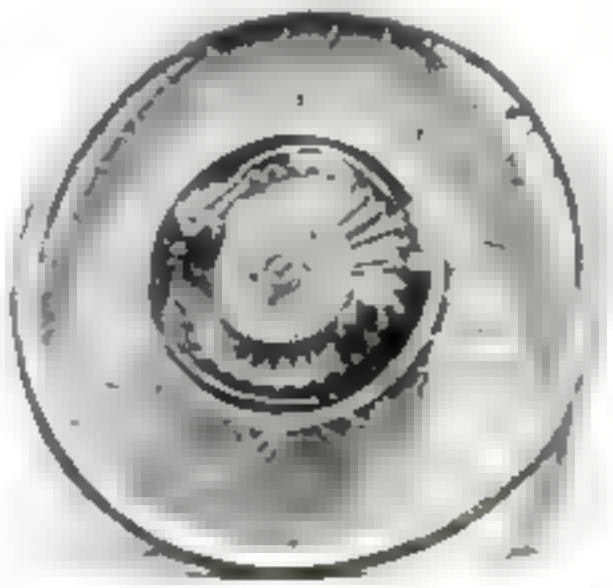
LOCK AND KEY COMBINED

A UNIQUE lock, which combines the convenience of the key type with the secrecy of the combination lock, is the invention of Oswald von Mehren, New York electrical engineer. It may be applied to a front door, automobile, or any other purpose for which a lock is used. The user carries a wide, flat key a little more than an inch long. Beneath its hinged covers, a series of notched bars forming the outline of the key may each be moved to any one of five positions. The owner adjusts them as he wishes, then inserts the key in the lock and gives it a half turn. On withdrawing it, the lock is automatically set to the chosen combination. Thereafter only the special key, adjusted to this secret combination, can open it. If he wishes, the user of the lock may easily change its combination every day, and with a key of this size more than 15,000 different combinations are possible

STEAM ENGINE BUILT OF GLASS



A TOY steam engine built entirely of glass, that actually runs, was the masterpiece of craftsmanship that seventy-three-year old, A. A. Scott, of Long Beach, Calif., recently presented to his grandson on the youngster's third birthday. Reputed to be the oldest glass blower in America, Scott took eleven months to build the 374 parts of engine and join them together. The three-foot-long model which is twenty-two inches high, has a governor, two flywheels, double pistons, and a boiler that is fired by a tiny alcohol lamp. According to Scott, this unique engine toy develops one-twentieth of a horsepower. Its chief appeal as far as the child is concerned, lies in the fact that its internal operations are visible.



TALKIE MOVIE SHOWN ON WARSHIP

Sailors on the U. S. S. Pennsylvania were shown talking movies on the warship's deck.

TALKING movies were shown for the first time on a naval vessel the other day when the decks of the U. S. S. *Pennsylvania*, at the Philadelphia Navy Yard were transformed into a sound motion picture theater. A screen was set up at one end of the deck, backed by huge horns to provide the sound effects.

PLACE FOR BLADES

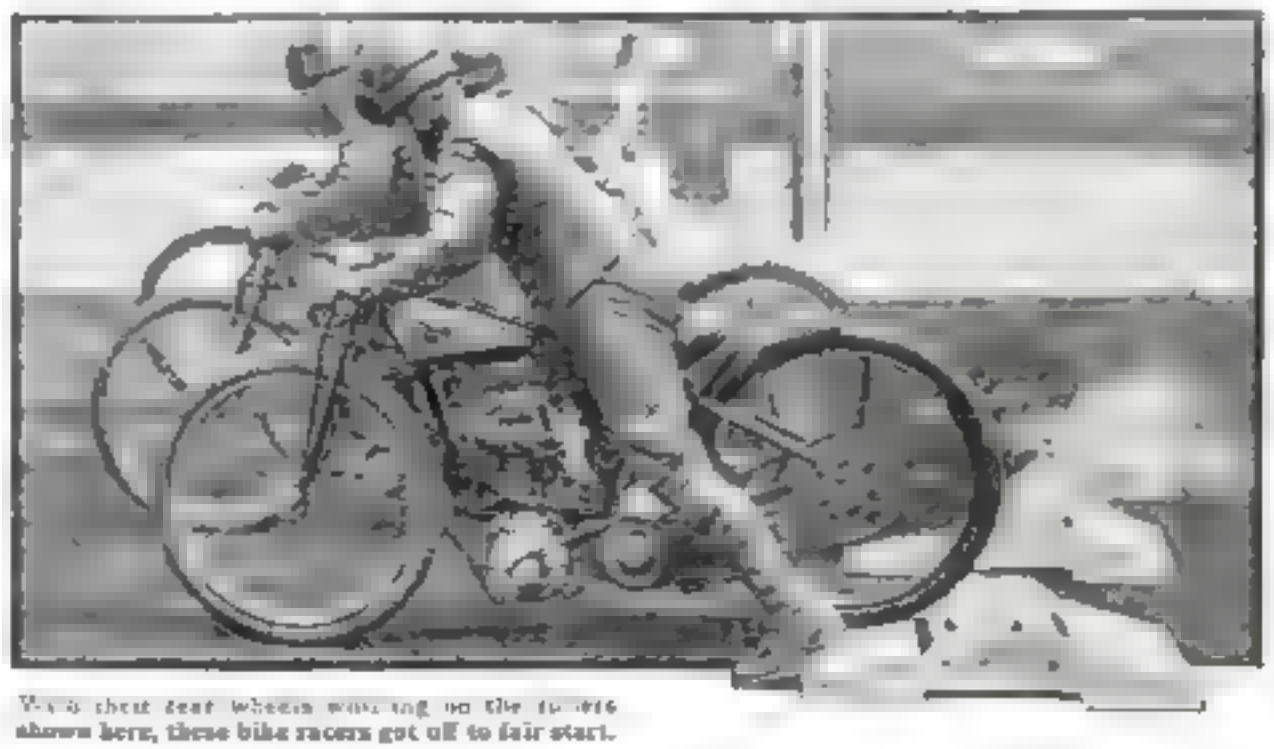
WHAT to do with old razor blades is a problem solved temporarily, at least, by a receptacle for the bathroom wall. Discarded blades are dropped through a slot in the cover. Spring clipholdscontainer

BUILT-IN ENGINE TURNS BIKE INTO MOTORCYCLE

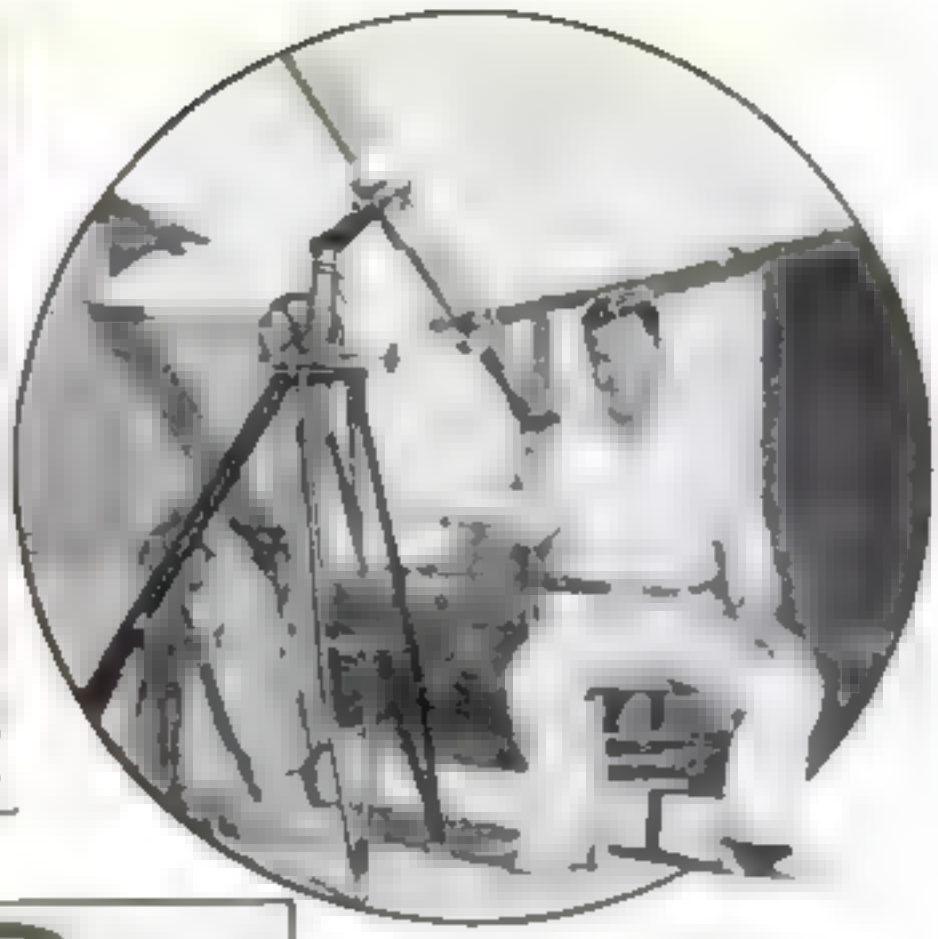
REMOVING the rear wheel from a bicycle and substituting a new wheel with a built-in motor transforms it into a motorcycle. This new invention contains a one-cylinder, air-cooled engine of unusually compact design, as shown in the photograph. Operated by handle-bar controls, it may be attached to any bike. The entire motor weighs only fifty-six pounds, and the manufacturers claim it is speedy and economical of gasoline. Fuel is supplied from a gasoline tank that may be installed at any convenient place on the bicycle.

MOTORBIKE RACERS ARE STARTED WITH ROBOT

SO THAT motorcycle racers can get off to a flying start, an unusual "starting robot" was tried out not long ago at the Wembley Stadium, London, England. This consisted of a pair of rollers on which the rear wheel of each motorcycle was placed. With the wheel spinning, contestants warm up their motors until the signal to start is given. Then they push their machine off the rollers, and are off at full speed. The purpose of the robot device is to prevent an unfair advantage being gained by one rider over another. Officials say it insured a real test of speed as well as driving skill.



With their rear wheels whirling on the rollers shown here, these bike racers get off to fair start.



TURNS COAL INTO MOTOR FUEL

[illegible] country and abroad. At the Departm[illegible] of Scientific and Industrial Research, [illegible] Greenwich, England, where experts [illegible] to improve the process of [illegible] under the terrific pressure of 3,000 pounds to the square inch is made to combine with coal in these specially-constructed converters and a fuel resembling gasoline is obtained as a product. The labels in the picture show the steps in [illegible]

This famous rotorship, with no propeller but revolving cylinders, got a belated trial.

MOVE GERMAN TROOPS IN FAMED ROTORSHIP

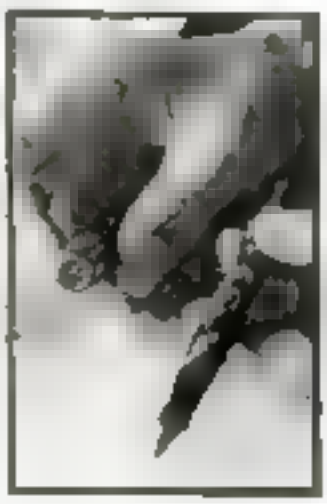
One [illegible] when [illegible] Captain [illegible] [illegible] by Anton Flettner, German engineer, nearly a decade ago was hailed as inaugurating a new era in navigation. But despite a transatlantic voyage by one of the ships, they dropped from the news and after the construction of the *Barbara* in 1926 were definitely abandoned. Instead of using marine propellers, a rotorship uses whirling cylinders in the air. They are spun by motors, and the force of the wind acting upon them propels the craft forward.

JAPANESE GARDENER FINDS NEW COMET

[illegible] reported his find to [illegible] of star pictures will be made in an effort to discover the periodicity of the comet.

PENCIL, COMPASS AND PEN IN ONE HOLDER

A new instrument of many purposes combines in one a pen, pencil, and compass. The latter is mounted in the top of the cap. Extra leads are carried in a magazine at the base of the pencil. The fountain pen is of the lever-filling type and holds the usual amount.



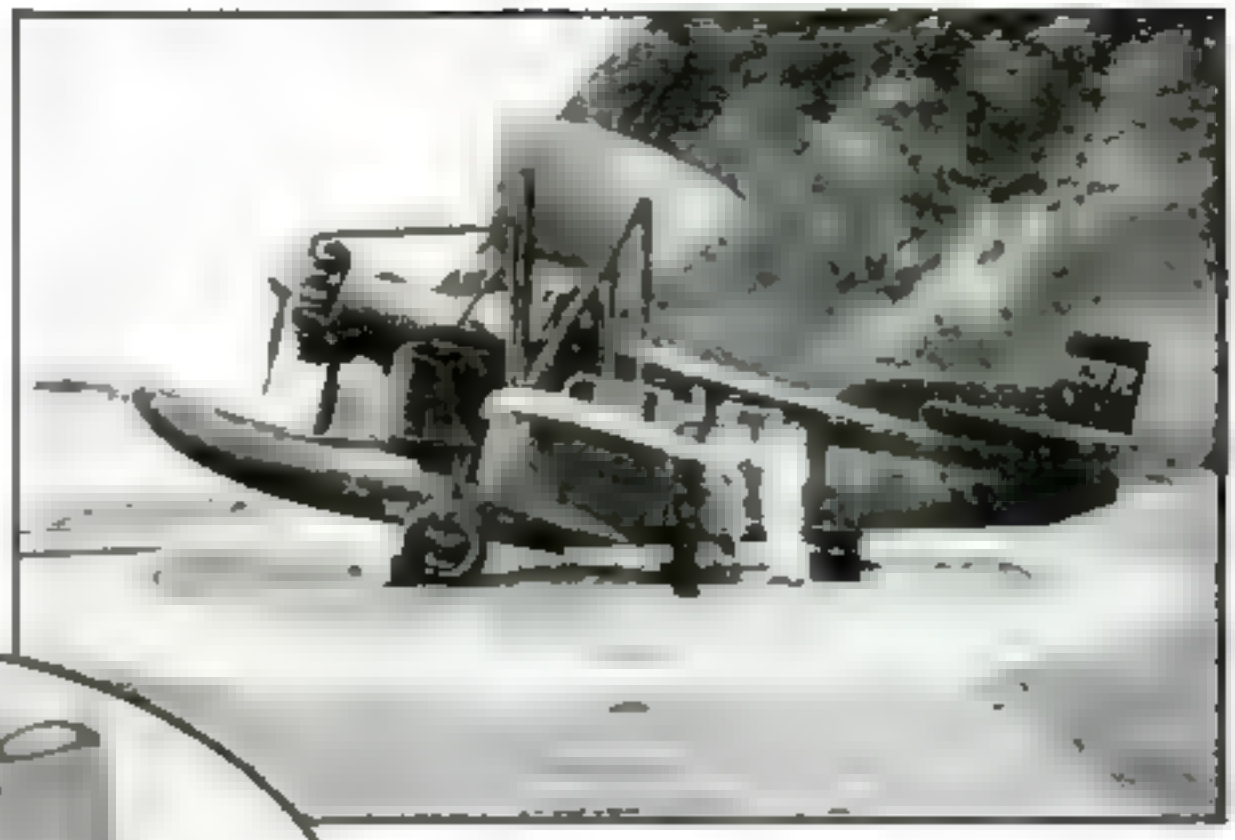
RECONSTRUCTS EXTINCT DODO BIRD

Familiar as a figure of speech is the dodo bird—but no one living ever saw one, until Prof. Homer Dill, of the University of Iowa Museum, set out to re-construct the strange bird for modern eyes. After a search of many years, in which he examined crumbling old manuscripts and gathered information and measurements, he has just completed a restoration of the dodo. The original dodo bird was a flightless pigeon larger than a turkey. It lived on the island of Mauritius, off the eastern coast of Africa, until it became extinct about 1681. It had an enormous bill, short legs covered with scales, and curly tail feathers as shown in picture at the right.

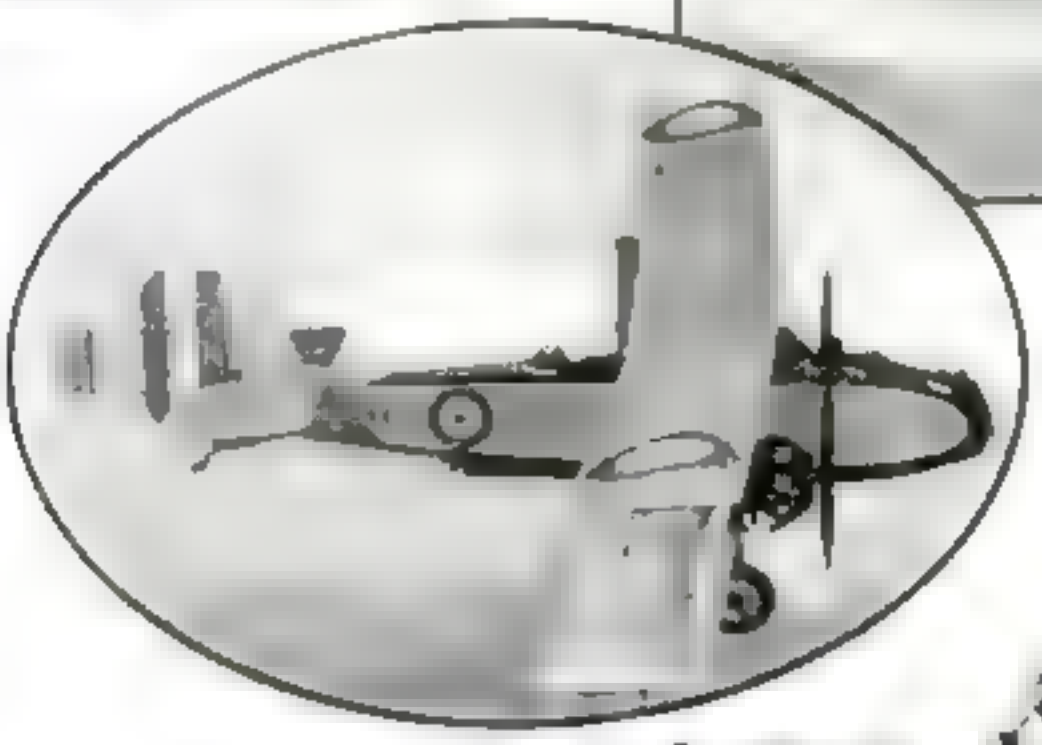
Homer Dill, of University of Iowa Museum, and his reconstruction of the dodo bird which became extinct in 1681

Turntable on Island Used to Head Planes Back to Sea

THE principle of the turntable used in railroad roundhouses to revolve locomotives has been applied by Philip K. Wrigley at his Catalina Island, Calif., airport for turning amphibian planes so they head to sea. Situated in a narrow canyon, the island air base proved too small to allow planes to turn around by "taxiing." The turntable, twenty-six feet in diameter and electrically operated, does the trick Catalina Island is situated twenty-five miles off the southern California mainland. Amphibian planes cross the channel in fourteen minutes, land on the water and taxi to a forty-foot concrete ramp, lower wheels and run up the slight incline and onto the turntable. When a button is pressed the table turns.

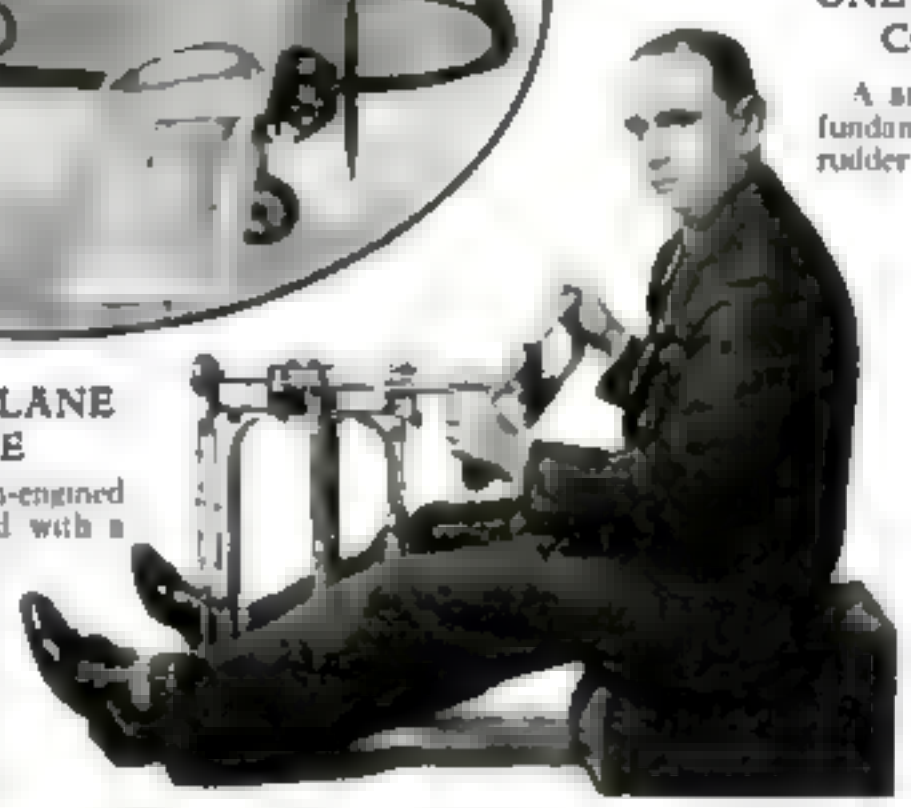


This electrically operated twenty-six-foot turntable has been built on Catalina Island to swing big sea planes around.



TINY RUDDER ON PLANE WORKS A BIG ONE

SEVERAL of England's twin-engined bombing planes have been fitted with a new type of rudder control in which a little rudder works the big one to make steering easier. When the small auxiliary rudder, on outriggers, is turned by the pilot, it swings the larger surface in the opposite direction. A modification of this scheme is used in America.



Richard P. Mueller student pilot demonstrates the new three way control for airplanes which he has invented.

ONE WHEEL WORKS THREE CONTROLS IN PLANE

A SINGLE hand wheel works the three fundamental controls of an airplane—the rudder for horizontal steering, the elevators for vertical steering and the ailerons for banking—in a new control system invented by a student pilot. It is designed to simplify flying for the beginner, since it replaces the hand-operated "joy stick" and the foot-controlled rudder bar now in standard use. Though all controlled through the single handle, the controls are entirely independent of each other. Rotating the handle like the steering wheel of a motorboat or car operates the ailerons. Pushing one side forward and pulling the other back works the rudder. The entire handle may be thrust forward or pulled back, and in this way the elevator is operated.

This new airplane propeller has overlapping blades which reduce its size and, according to the inventor add to its efficiency.

NEW PROPELLER'S BLADES OVERLAP

STRIKINGLY unconventional in design is an airplane propeller developed by a New York inventor, with three wide, stubby blades that overlap. Because of its unusual shape the designer expects it to grasp the air with high efficiency, and he says that tests in a wind tunnel have confirmed this view. He has built a small non-flying model plane with an electric motor installed to demonstrate the invention. In use, the propeller would cover much less of the plane's nose; in fact it would be so compact that in a military plane the machine gunner would be able to fire over the propeller blades instead of through them. A full-sized model of the propeller is under construction and will be tested soon on an airplane at a Long Island, N. Y., flying field.

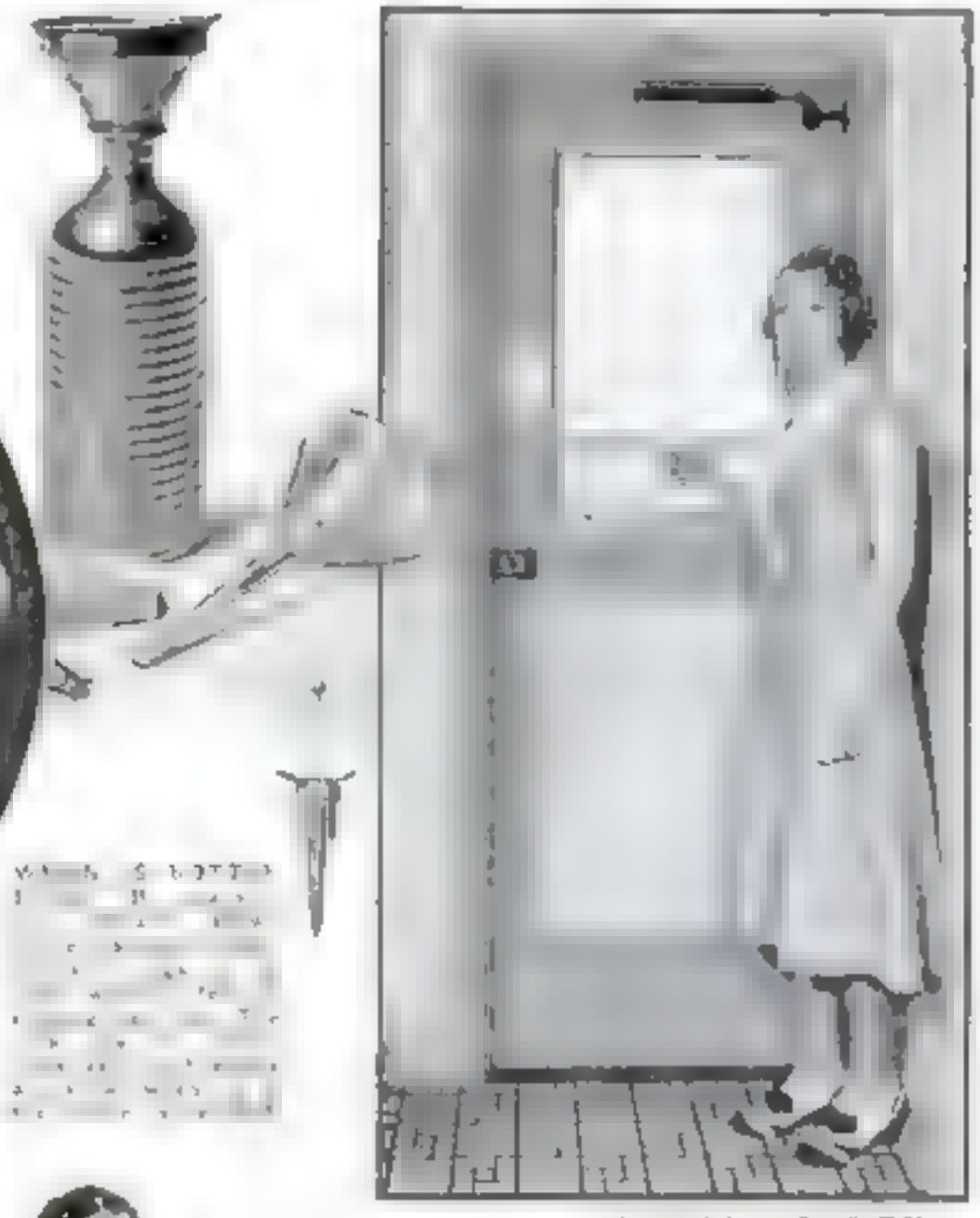
NEW NON-STOP RECORD

THE Federation Aeronautique Internationale, world arbiter of airplane records, has confirmed the distance mark of 4 995.9 miles made by Russell N Boardman and John L. Polando in their nonstop flight from New York to Istanbul, Turkey. This beats the record of Dieudonne Costes and Maurice Bellonte, French aviators who flew 4,913 miles from Paris to Manchuria.

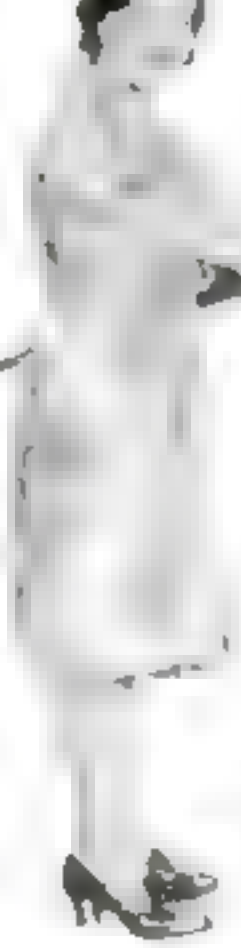
New Mechanical Devices

IRON WITHOUT PRESSURE

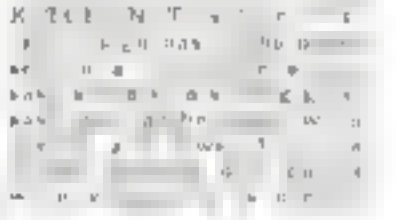
SPRAY WINDOW CLEANER

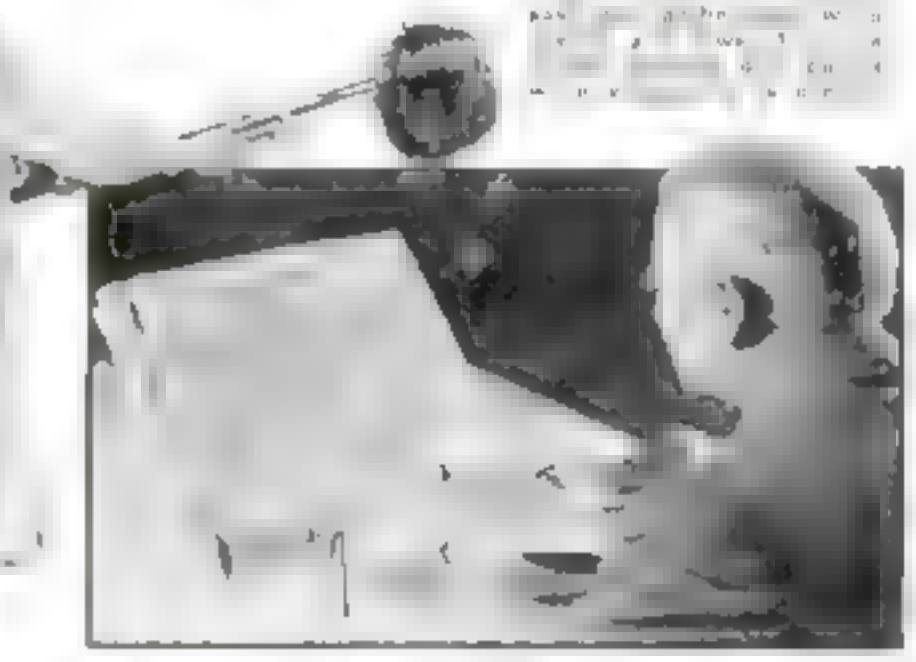


DISH ON BALL BEARINGS. With the dish shown here, hors d'oeuvres are served in a most attractive manner. The dish rests on ball bearings and turns at a touch. Seven dishes are nested to accommodate a variety of tidbits.



BUMPER FOR MOP With a rubber tipped bumper attached to your dust mop you can shake it as vigorously as you like without breaking it, as the rubber guards it when it strikes against hard objects. Thus all dust can be easily jarred out





READ AND EAT

any dining table setting

LOCKS HOLD SCREENS At right is shown a lock that attaches to inside of screens in place of the ordinary outside buttons. It holds the screen in place and locks it.

Make Housekeeping Easy

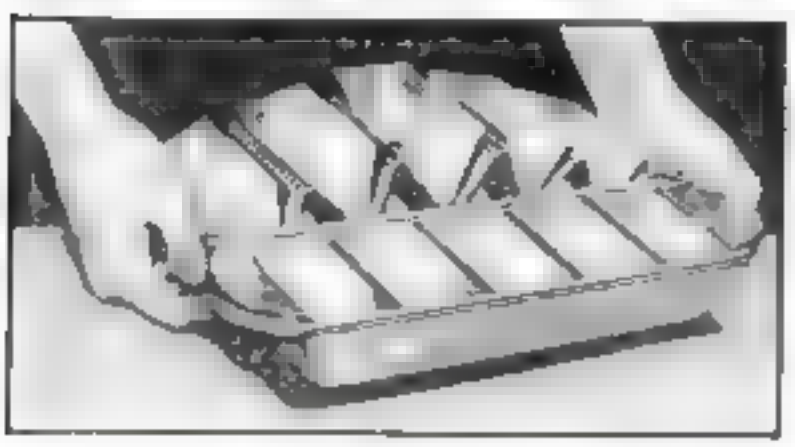
SOMETHING DIFFERENT IN SINKS. At left is shown a kitchen sink made of a metal that looks not unlike the platinum that goes into expensive jewelry. It is designed to give attractiveness to the kitchen and aid cleanliness.

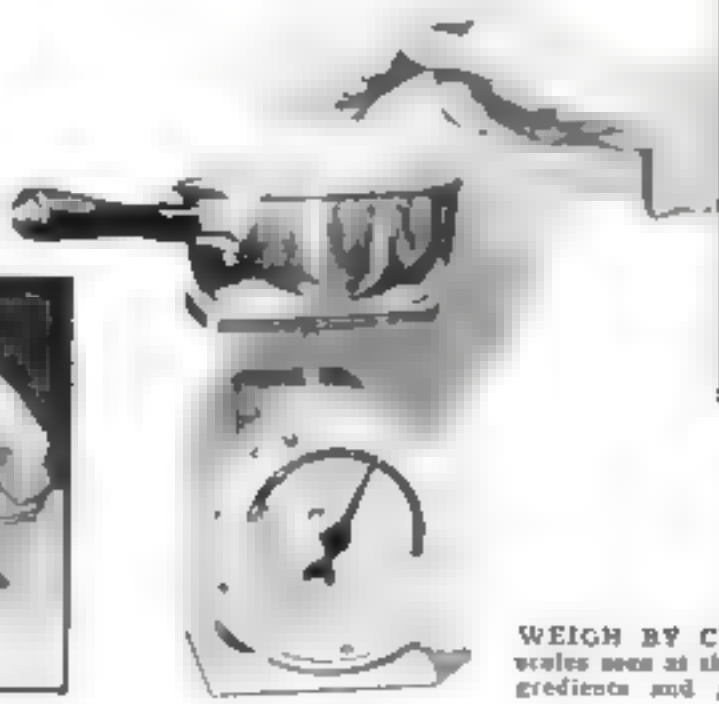
BLACK BOTTOM COMES BACK At the right is shown a new enamel ware that has a bottom finished in black to hasten the absorption of heat. Rim and cover form a water seal to conserve heat of steam.

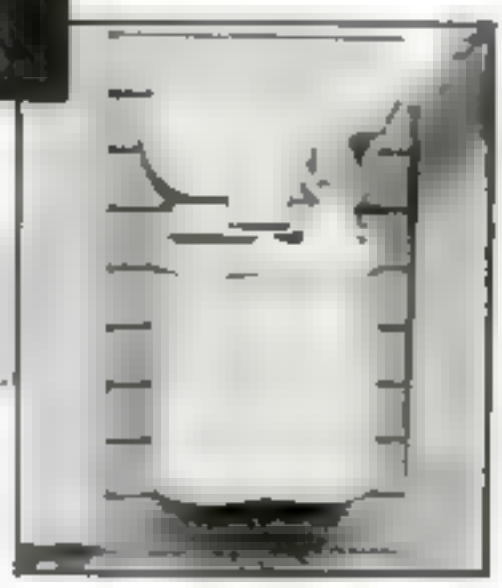
ELECTRICITY DRIES THE CLOTHES. Below is an electric heater that has a clothes sweep attachment that opens its arms to provide room for garments you wish to dry. It folds compactly and the sweep is removable when heater is being used to dry hair or merely as a heater.

BABY'S DRESSING TABLE. The canvas topped, metal framed table seen at left is designed for use in the bathroom. It attaches firmly to wall above bathtub and folds up out of the way when not in use. Baby sinking into the canvas top, is not in danger of falling off unexpectedly.

ICE CUBES THAT DON'T STICK The tray below is made of saw-tooth grids of tinned iron bar metal that molds the ice into triangular shaped bars. Pressure on the rod of grid frees it from tray and a sling or twist releases the ice.

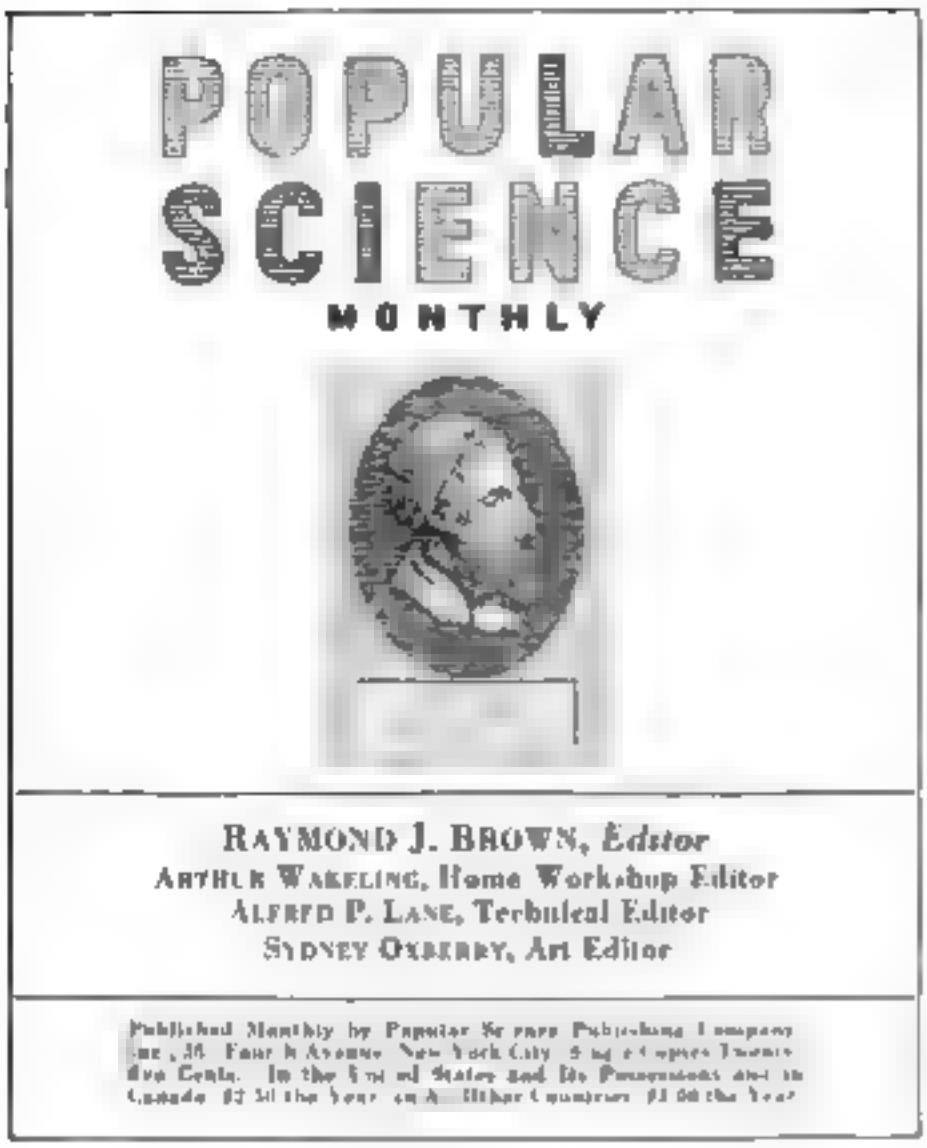






PROTECTS THE MILK. A milk dealer is providing his customers with a two-bottle container that can be attached to the wall with screws or stood on floor. It is made of fiber and is said to keep milk cool.

WEIGH BY CUPFULS The kitchen scales seen at the left weigh cooking ingredients and give result in cupfuls.



Can a Robot Have a Nose?

A BOUQUET made up of roses surrounded by sprays of garlic wouldn't make a hit with most people, but the combination would seem quite all right to the man who has lost, or never possessed, a sense of smell.

Science can do nothing for such a man. No device so far invented can detect a smell. We have mechanical gadgets more sensitive to sound than the human ear, mechanical methods of feeling much more delicate than the human touch, electrical eyes to detect light, but the science of smells and how to detect them is still at the starting point. Those of us who have noses in working order can distinguish between a piece of garlic and rose without touching them or seeing them.

What is a smell? Obviously something must enter your nose and excite the nerves therein to produce the sensation you recognize as smell, but what is it? It cannot be an electronic action because an electron shot off from a piece of garbage would be just like the electron escaping from the finest perfume. Scientists may argue as to the exact form of an electron, but they are united in believing that whatever its form, all electrons are precisely alike.

It is evident, therefore, that what affects your nose are the tiny particles of some tenuous, otherwise imperceptible gaseous material thrown off by the substance producing the smell. The action undoubtedly is electrochemical in nature carried out on an almost inconceivably small scale. The extreme sensitivity of the human nose proves that.

Of course there are mechanical and chemical methods of detecting many types of gases, but the action in such cases usually depends on a relatively coarse chemical action not to be classed with the delicate operation of the animal or human nose.

The close relation between taste and smell has long been known. Tests have shown that the sense of smell is far more important than the relatively crude sense of taste. Everyone has noted how food seems to be "tasteless" when the eater has a severe cold.

Now along comes Dr. Blakeslee of the Carnegie Institution to show us how very little is actually known about either of these interacting senses. He has found that there is a wide variation in taste perception even among people of normal senses. He found a certain chemical that to some people had the bitter taste of quinine and to others seemed quite tasteless.

Undoubtedly the same situation exists with relation to the sense of smell. To one person a certain smell may be virtually non-existent. To another, the same smell may seem powerful and excessively repugnant. To a third it may seem a mild and attractive odor.

Big Variations in Senses

THE SITUATION with regard to smelling and tasting consequently parallels seeing and hearing. While complete color-blindness is rare, inability to see one or more colors is a common failing and there are plenty of people who are so tone deaf they cannot tell the difference between a third rate jazz band and the finest symphony orchestra. Music is just noise to them.

Variations in taste perception amounting in extreme cases to "taste blindness" explain why one child will put up a strenuous fight against taking a certain medicine and another will lick a spoon containing it.

Both smell and taste are vitally important to all wild animals. Without them they cannot long survive in the struggle for existence. Human beings are not so dependent on these two senses. Their loss or absence, however, is a source of potential danger to life. A man was recently killed by gas because his sense of smell was so deficient that he couldn't smell it escaping from an open stove burner.

The sense of smell also is important in many lines of business and in the pursuit of many forms of pleasure. A butcher who could not recognize the odor of spoiled meat would soon lose his customers and nobody can estimate how much of the joy of camping hinges on the smell of frying breakfast bacon and the keen tang of pine woods.

Experimenting with a Lemon

NATURE provided us with five senses and these five all cooperate. The impression you get by way of one sense is linked up with and confirmed by that received from any of the other senses brought into action.

An experiment made with a lemon shows what happens when the senses turn in conflicting reports. The strong smelling yellow fruit was completely deodorized by powerful solvents and was then perfumed with a trace of oil of rose. It was submitted to several people. The tests show how the senses of sight and smell work together, for some people decided that it smelled like an orange, others that it had the odor of a spoiled lemon, and a few thought it smelled like artificially flavored lemon candy. The eye said lemon, the nose said rose, and the brain scrambled these opposing impressions with weird results.

We have glasses to help those with defective vision, hearing aids for the partly deaf, and who now will produce an artificial device to improve the smelling ability of people with subnormal noses?

NEW SETS

Are the Best in History of Radio

By
ALFRED P. LANE

In the Popular Science Institute laboratory the new radio sets have been given rigid tests and these results compared with records of previous models show 1932 receivers have high selectivity

Superheterodyne Circuit Found in Nearly All 1932 Receivers—Selectivity Now Fine

IN SEVERAL ways the new radio receivers now being announced are vastly superior to previous models. Every radio set owner and every prospective set buyer is interested in knowing just how the new sets are better than the old ones. If you now own a set, you will be particularly interested in knowing how great these improvements are in actual figures.

Generally speaking, the new sets will be smaller than last year's models figuring grade for grade. Not much change is to be expected in appearance although of course this fall's models will be housed in cabinets constructed in the latest style. Naturally there are minor changes and improvements in dial construction and other details.

Aside from appearance, the choice of a radio receiver depends on four main points of performance. These are sensitivity, which means the ability to bring in distant stations; selectivity, which is the measure of a receiver's power to choose between stations close together on the dial; tone quality or faithfulness in reproducing speech or music; and volume, the strength of the sound impulses which can be developed from the loudspeaker without distortion.

Nearly every important maker of radio receivers has now shifted over to the superheterodyne circuit except for the lowest priced models. Last year superheterodyne circuits were in the minority. This rapid change has been due to new licensing agreements and to important improvements in the superheterodyne circuit itself. These were described in a previous article (P. S. M., Feb. '31, p. 84).

The Popular Science Institute has been testing radio receivers for many years and has, in consequence, complete records of the performance characteristics of virtually all the good sets made in previous years. After this year's models had been tested, last year's records were consulted for comparison and as all tests have, for some time, been carried out on exactly the same basis, it has been an easy matter to strike averages and so compare the performance of the new season's offerings with last year's models.

The sensitivity of the average new model is better than last year's set. However, this is, for practical radio reception under average conditions, quite unimportant. In fact, such improvement as there has been in sensitivity was not deliberately sought by the manufacturers. It came as a natural result of other improvements. The reason why improved sensitivity is nearly useless is because there is always a certain amount of static in the air on all wave lengths and when the sensitivity is pushed beyond a certain limit the static drowns out any signal that might otherwise be heard.

IN SELECTIVITY the superheterodyne receivers of several different manufacturers set a new high order of performance.

In order to understand how great this improvement has been, it is necessary to know how the selectivity of a radio receiver is determined.

Obviously, no laboratory worthy of the name would judge selectivity by hooking a radio receiver to an antenna and then attempt to tell, by listening to the loudspeaker, how the set performed. A test made that way would be quite meaningless because no two people making the test would get the same result and the same man repeating the test on successive days would get different results each day owing to changes in the strength of the broadcasting and so on.

THE laboratory method is to use a precision-built oscillator which produces a minature radio wave of any desired frequency and strength. The oscillator is carefully measured so that the exact strength of the minature wave is known for any setting of the controls. The oscillator is set first to produce a wave in tune with the set and then exactly ten kilocycles off tuning. Electrical measuring instruments are connected to the output of the receiver under test so that the strength of the output of the set can be measured.

Assuming this arrangement is applied to a typical last year's set with the oscillator ten kilocycles off tuning and operating ten times as loud as when tuned to the set, the instruments hooked to the output of the

set would register both frequencies at about equal intensity. This means that the old set would receive two stations about equally loud if they were ten kilocycles apart in tuning and the unwanted station were ten times as strong as the desired station.

WITH exactly this same set up, a typical good 1932 set would show no interference at all!

If the strength of the unwanted station were increased to one hundred times that of the desired station, the new set would still bring in the station wanted louder than the unwanted station whereas the older set would register the unwanted station considerably louder than the wanted one.

Carrying the test still further by increasing the signals of the unwanted station to 1,000 times that of the wanted one, the latest type set would get both about equally loud. With last year's set the unwanted station would be so loud as to drown out the wanted one

These figures show that the average new set has been vastly improved, but you must not think that they completely solve the interference problem. Serious interference still is quite likely even with the best set now made. Remember that situations are often found where the local station, only ten kilocycles removed from a distant wanted station, may be received with a million or more times the energy measured at your antenna. Under such conditions you can not expect to get the distant station without local interference no matter what set you buy.

There was a time, as the records of the Popular Science Institute show, when the average radio receiver was far more selective to stations on the upper end of the dial representing the lower frequencies, and far more sensitive to stations on the lower end of the dial representing the higher frequencies

Selectivity and sensitivity figures obtained by the method outlined held good only for one point on the dial. At other points the figures were sure to be different That is why, with older type sets, one man might report excellent selectivity with a certain make of receiver and another report excessive interference with exactly the same set. It all depended on whether the excessive interference occurred on the upper or lower part of the dial

In the new superheterodyne circuits this unequal selectivity and sensitivity has been almost completely eliminated Sets for this year will have uniform reception characteristics over the entire broadcast frequency band

The greatly improved selectivity of the new sets has made useful a greater degree of sensitivity

This is because static noises are under ordinary conditions, spread all over the broadcast band and consequently, the broader a set tunes, the more static will be received for any given degree of sensitivity. With every improvement in selectivity, the receiver becomes that much less sensitive to the static that is coming in on bands close to the tuning point of the receiver

This means that the radio enthusiast who is interested in bringing in distant stations will have more success with a new set than is possible with his old one. He will find the new set less 'noisy' and consequently he will be able to recognize and log the call letters of distant stations with greater ease.

The question as to how much improvement in tone quality you will find in the new sets depends on whether you are interested in a high grade, high priced set or in one of the more popular priced models

There has been virtually no improvement in the tone quality of the sets at the top of the price and quality scale. This is not surprising in view of the faithful tone reproduction attained last year. It has, in fact, been possible for several years for any manufacturer to produce a set having tone quality characteristics closely approaching the ideal. The circuits, tubes and parts have been on the market for at least that length of time

This applies to radio receivers using push-pull audio amplification with the highest grade audio transformers and power tubes such as the type 245 or 250, and with the best available dynamic cone loudspeakers

On lower priced sets the situation is not the same. In the past the manufacturer of such receivers has found it impossible to put in the type of circuit capable of giving plenty of volume with reasonable tone quality because of the expense of the parts involved. The introduction of the new pentode power tube type 247 (P. S. M., July '31, p. 76) has made possible a great improvement in tone quality in the lowest priced sets. In addition to handling much more power, it also amplifies to a far greater extent so that the first audio stage can be eliminated without loss in volume. This permits a saving in assembling and wiring and therefore makes possible the building of a better set in the low priced brackets.

THIS saving also is passed along to you as the radio set owner because cutting out the first audio tube means one less tube to buy when replacements become necessary. There is, in addition, a slight decrease in the amount of current required to operate sets using the type 247 tube with a corresponding decrease in the cost of operation.

The maximum volume without distortion possible to obtain from the new receivers in the higher price classes is but little greater than could be had from previous types. This, however, is of but little importance because sets employing the 245 tubes in push-pull circuits, the most popular combination last year for the better grade sets, could produce much more volume without distortion than most people wanted. The power handling ability of the new type 247 is so great that one of them almost equals two type 245 tubes in the push-pull circuit. This means that getting enough volume is no longer a problem with even the most inexpensive sets now available

Of course automatic volume control is now a standard feature of nearly all of today's radio receivers. The advantages of this feature as well as that of various methods of visible tuning were discussed last month (P. S. M., Sept. '31, p. 68). The greater power handling ability of low priced receivers has proved an incentive to the manufacturers to install automatic volume control even in these sets. When the possible volume output is great, ear-piercing noises are produced when the dial is twirled if there is no automatic volume control This would be especially true in cases where the set happened to be tuned to a weak, distant station and the hand volume control was set to a correspondingly high level.

In appearance and performance it would appear that radio sets are more nearly standardized this year than ever before though some are inferior to others

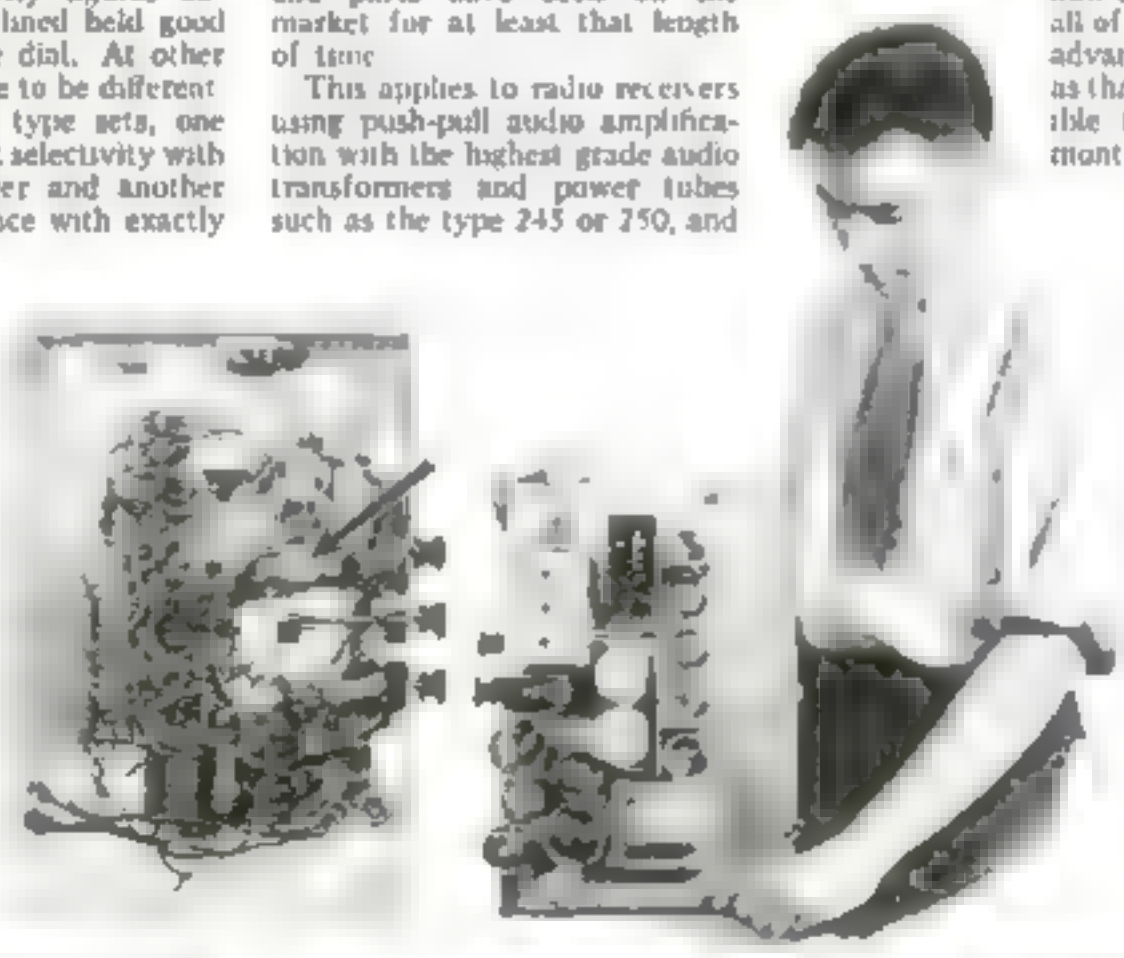
How New Sets Excel

GREATER selectivity is the main point of superiority that the new model radio sets have over those of last year.

Sensitiveness shows little change.

Volume is greater than any fan could desire.

Cabinets are compact and of latest design.



One of the new superheterodyne sets, right being set up in the Popular Science Institute for careful testing. At left arrow indicates one of the new tuning units found in the 1932 radio receivers.

Soldering is EASY

...If It's Done Right

Clean Surface and Flux Insure Good Work

WHAT actually goes on when you join two pieces of metal by soldering? Many beginners at radio experimenting do not know, and that is the main reason why they find soldering so difficult.

Unlike most home workshop operations, soldering requires relatively little skill. Drilling a hole and getting it straight or planing the edge of a board requires considerably more manual dexterity than does soldering, yet home workshop enthusiasts who do not hesitate to tackle the most difficult home workshop tasks often shy away from the simplest job of soldering.

Many also get the idea that soldering is permanent, that a job once soldered cannot be taken apart without considerable difficulty. This, too, is a mistaken belief for soldered connections usually can be opened in less time than it takes to unloosen a corresponding number of binding posts.

Radio soldering and most home workshop soldering is best done with a solder composed of half tin and half lead, known to the trade as "half and half" solder. In theory a solder joint is one where two similar or dissimilar metals are joined by means of solder, the latter making intimate, almost molecular contact with the surfaces of both metals.

The difficulty, if any, in making such a joint invariably comes from failure to obtain the necessary intimate metal to metal contact between the solder and one or the other of the two metal surfaces that are to be joined. Oxidization is the chief cause of this trouble. With the exception of gold, platinum, and certain other precious metals, a fresh surface quickly attains a filmlike coating of oxide. In the case of aluminum this coating forms almost instantaneously, which is one of the reasons why aluminum cannot be soldered by ordinary methods.

In order for the solder to make intimate contact with the true metalic surface, this thin oxide coating must be removed and kept away until the solder has a chance to flow onto the bare metal. Fluxes are used to accomplish this purpose. For electrical work, rosin makes an excellent flux, although it is not so quick-acting or powerful on badly corroded surfaces as some of the special soldering pastes.

REMEMBER, the fact that the surface looks clean and bare is no proof that it actually is in that condition. The film of oxide may be there and yet be so thin as to be practically invisible.

In order to show, as graphically as possible just what soldering flux does the remarkable close-up photographs on this page were specially taken for POPULAR SCIENCE MONTHLY. In the picture in the center column, a piece of radio bus wire of the ordinary tinned variety was placed with a bend at the end in contact with a piece of thin sheet brass. Then an electric soldering iron, which had been plugged in long enough to get up to operating temperature, was braced in position with its solder coated tip resting on the end of bus wire. The photograph shows a droplet of solder hanging down from the end of the iron and resting on the sheet brass in a globular state like a drop of mercury on a table top. Note that the solder is acting somewhat standoffish. It does not seem to want to flow onto either the bus wire or the sheet brass.

Above, soldering iron, heated to the proper operating temperature is brought in contact with the end of a piece of bus wire. Note droplet of solder hanging down and refusing to flow onto either the bus wire or the sheet brass. At right the solder flowed freely after a bit of soldering paste had been touched to the side of the iron near the tip.

THE camera was made ready for another exposure and then a drop of soldering paste was touched to the side of the iron near the tip. It melted and flowed down over the tip, the globule of solder, the end of the bus wire, and onto the brass plate. Immediately thereafter the solder flowed down and the camera shutter was snapped again to picture the excellent solder joint shown in the lower picture in the third column. Note that in this test neither the soldering iron, the piece of wire, nor the sheet brass was touched or disturbed in any way other than by the addition of the flux as already mentioned.

As these illustrations prove, virtually no skill is needed in soldering. It is all a matter of getting the surfaces as clean as possible, using good soldering paste or rosin core solder, and allowing sufficient time for the heat from the iron to flow into the joint and warm the metal surfaces to approximately the temperature of the molten solder.

A B C's of Radio

MANY prospective radio enthusiasts spend time and money installing elaborate antennas before attempting to use their new receivers. With modern radio receivers much of this work often is wasted because the new sets are so sensitive that a big antenna is unnecessary and in fact not desirable. When you get your new receiver try it first with a piece of bell wire strung around the picture molding for an antenna. If the location is especially poor for radio, you may have to add a short outdoor section. The limit of effective length is reached when the average static noise brought in when the volume control is full on is loud enough to be objectionable. A longer antenna might bring in more stations but you wouldn't be able to enjoy them because of the disturbing static.

By
MARTIN
BUNN

Hurt in Car Crash

A car owned and driven by H. D. Grandin, 342 West Main Street, was wrecked and Grandin sustained a fractured leg yesterday in a collision with a truck driven by John Gilroy at H. Ridbury crossing on the turnpike. Gilroy was uninjured and his truck was but slightly damaged. At the hospital it was said Grandin's injuries probably will keep him confined for three weeks or a month.

Conceit Makes Good Drivers Bad

"SORRY, Mr. Grandin," Gus Wilson apologized to the owner of an expensive sedan that had stopped at the Model Garage. "I'd be glad to go out with you and see if I can locate that funny noise but, you see, I'm expecting a phone call any minute now. Bring the car around tomorrow or the next day when you have time to leave it so I can give it a good going over."

Grandin started his car and drove off with the effortless ease of the expert driver. Joe Clark eyed his partner speculatively. It wasn't like him to pass up jobs, but Gus went back to the car on which he was working without offering any explanation. He finished it a few minutes before the owner walked in.

"All ready, Mr. Meekins," he said. "Drive me around a bit so I can see if everything is in good shape."

Meekins smiled confidently. "I'm not so very good as a driver, Gus, but if you don't mind hearing the gears grind once in a while I'd be delighted to try it out that way."

By the time they returned Joe's curiosity was working.

"Tell me, Gus," he asked, "why you hand Grandin a phoney excuse to get out of driving with him and then invite yourself for a ride with a dub like Meekins? Anybody with half an eye can see Grandin is a far better driver."

Gus grunted. "Did you ever try to drive a horse over a bridge that looked all right but wasn't really safe, and then have the horse kind of snort and refuse to put a foot on the bridge? That's how Grandin affects me, except of course the horse only has his instinct to go by while I've got reasons for acting as I did."

"What are they?" Joe argued. "Grandin can drive rings around Meekins any day in the week. You don't mean to tell me an expert driver is not as safe to ride with as a dub, do you?"

"Sometimes he is and sometimes he isn't," Gus said noncommittally. "Have you talked with Grandin enough to know him?"

"Sure I have," Joe asserted. "He's about the most conceited bird I've ever met. The world revolves around Grandin—according to him. But what's that got to do with driving a car? There's nobody around here handles a car any better than he does."

"I'll admit that," agreed Gus. "But the point is, a conceited, egotistical man, or woman, is mighty likely to be a dangerous driver no matter how expert he is at handling the gear shift and steering wheel."

GUS Says . . .

EVERY now and then you see a car with mudguards rusted through in spots. It looks like neglect. Actually it may be a case of too much care bestowed on the car when it was new. Many owners think they have to scrape all the mud off the underneath sides of the mudguards when they clean the car. There's no harm in that if the mud is washed off but using any kind of a scraper is sure to take the paint off in spots and there's where the rust starts.

"Why? Because the conceited bird always has it at the back of his skull that he's better and more important than the fellows he meets on the road. Whenever it's a question of who is to give way, the swelled-headed guy instinctively expects the other fellow to back water. When he blows his horn he just naturally expects other people to get out of his way.

"A bird like that is a bad risk for the accident insurance companies because sooner or later he is going to get into a mix-up with some one who either don't know how to handle a car or else has a swelled head too—then there's a smash."

"And if he comes out of it alive," Joe interrupted, "at least the swelled head shrinks a couple of sizes."

"Not if his bump of conceit is a big one, like Grandin's," said Gus. "He just naturally figures that the other fellow is entirely to blame and he goes barging along, letting the rest of the world watch out for itself."

"Maybe so," said Joe, "but if you took all the conceited drivers off the road there'd hardly be any motorists left!"

"G'wan!" Gus grinned. "You can't laugh it off that way. It's too serious. I'm not talking about just ordinary conceit. Every fellow ought to take a little pride in his own accomplishments. It's good for him. It makes him self-confident. I mean the bird that's so swelled up with conceit that he's lost all sense of values. He forgets that the other fellow has as many rights as he has.

"That," Gus continued, "is the real meat of this safe driving business—remembering all the time that the other fellow has as many *(Continued on page 133)*

Easily Built

Rowing Machine

Makes It Fun to Keep Fit

You can make your bedroom a gymnasium by constructing this sturdy, foolproof and inexpensive exerciser. It can be stored away under the bed

By CHARLES A. KING

THE energetic, well-set-up feeling you have acquired through the vigorous outdoor life of the vacation season should be preserved by continued exercise during the fall and winter. The question is, what kind of exercising can be done most conveniently and pleasurably in the confines of your own home?

Rowing machines or sliding seat exercisers have already answered the question. Machines of this type are being sold by the thousands at relatively high prices, but you can make one of your own without difficulty and at low cost—a machine that is large and powerful enough for a strong man and yet can be easily adjusted for women or children. Used in a horizontal position, it gives all the benefits of rowing, which has so often been praised as one of the best exercises for all-around development; and placed in an upright position it serves equally well as a wall exerciser.

The strain at about the end of the stroke may be 25, 50, or 75 pounds on each arm, depending upon whether one, two, or three rubber bands are used and upon the width of each. The user may change the number of bands at will to give the desired length of stroke and resistance.

The construction of the machine will be found surprisingly simple. For the sake of saving space in the text, numerous reference letters and figures have been used, but do not be deceived by them in thinking that there is any intricate or difficult work to be done. The photographs and perspective sketch will show almost at a glance the method of construction; and the working drawings, if studied along with the following description, will provide all the detailed information you need. It is important, of course, that a very hard wood such as maple be used throughout.

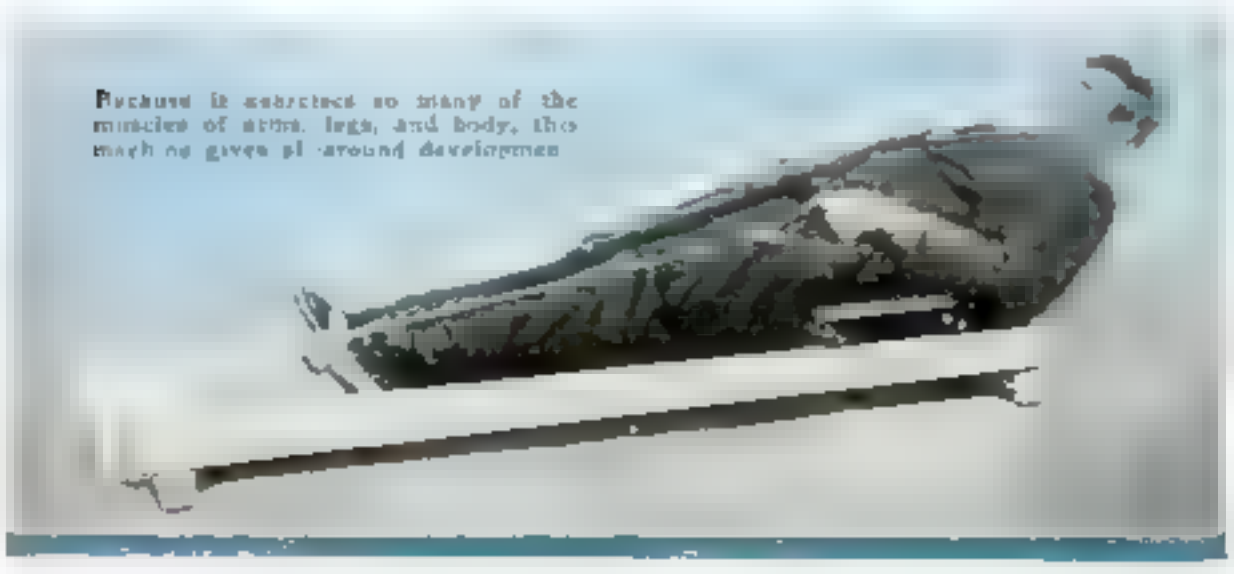
Prepare two side rails *A* 1-⅝ by 3 by 66 in. and cut groove *B* 9/16 by ¾ in. as shown in each side, making them right and left. Make foot *C* 1⅜ by 2 ¼ by 16 in., and foot *D* 1¼ by 3¼ by 16 in. At each end the latter should be notched to receive the sides *A*, as shown in the detail of the seat at the top of the drawing.

Assemble by boring ¼-in. holes *3* and *4* through *A*, *C*, and *D*, to receive ¼ by 5 in. carriage bolts, sinking the head of the latter flush with the top of *A* to allow the rolling seat to be slipped on and off. Sink the nuts in the bottom edge of *C* and *D*. Be sure the distance between the sides *A* is 11¼ in. The length of the separators *E* and *E*¹ *E* should be 1 by 9 by 11 ¼ in. and *E*¹, 1 or 4 by 11 ¼ in.; both should be squared to exact length and strongly fastened in place with 3-in. No. 12 screws as shown at *2*, for these pieces have to resist the racking tendency.

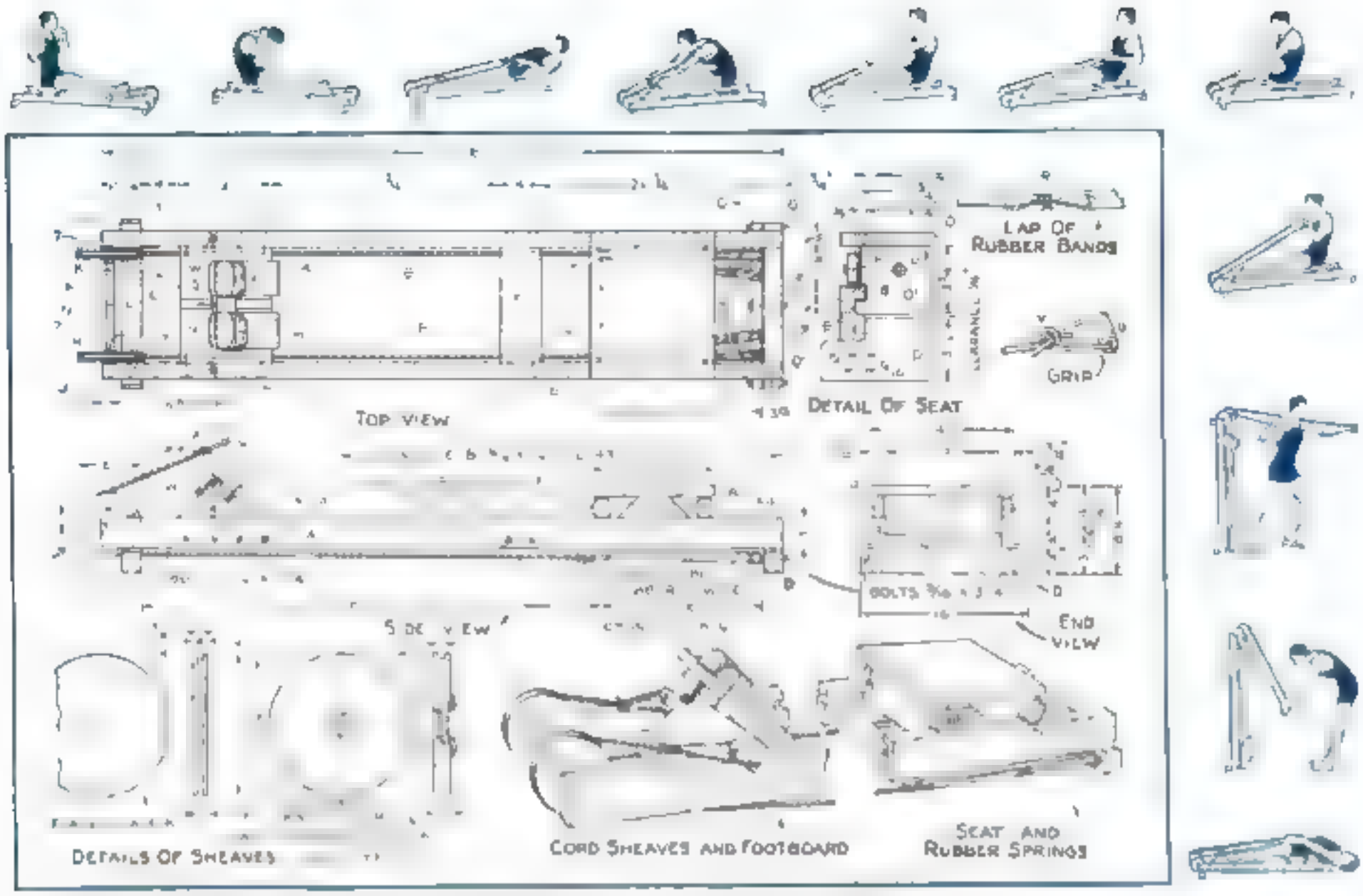
Cut the two foot rests *F* 13/16 by 3½ by 9 in. and cleat *G* 13/16 by 2 ¼ by 8 ½ in.; assemble with 1 ¼-in. No. 9 screws and fasten in place with 2 ½ by 2 in. hinges as at *4*, using 1¼-in. screws in the end wood of *F*. Make the triangular support *H* of 13/16-in. wood cut at an angle of 45° and fasten them to separator *E* with 1½-in. hinges as at *5*, which will allow both *F* and *H* to be folded out of the way when desired.

Locate accurately and bore a ½-in. hole in each rail at *I* to receive a ½-in. iron rod upon which the plain sheaves *K* revolve. These are each made of three wood disks, the middle one being ⅜ in. thick and 3 ¼ in. in diameter and the outsides ¼ in. thick and 6 in. in diameter glued with grain crossing and strengthened with 1-in. clinch nails.

Ball bearing sheaves may be made if preferred. Place 1-in. hardwood stock on the lathe faceplate and fit a ball bearing



Because it exercises so many of the muscles of arms, legs, and body, this machine gives all-around development



Top, side and end views of the sliding seat exerciser, details of the seat, sheaves, grip and rubber bands; and a perspective of the machine, broken away to show the construction.

skate roller in the center of the sheave. Turn the wheel to a diameter of 6 in. with a ⅜-in. groove in the center. If the ball bearing roller and axle cannot be found in the local hardware store, they may be bought cheaply from one of the large mail order houses. Make the wooden flanged cap L^1 as shown in the detail drawing of the ball bearing sheave. Glue it in place and drill two holes in the roller at 6 through which nails may be driven in the wood of the sheave to hold the roller rigidly. A ½-in. steel shaft should be used for the bearings of the sheaves, which will mean ½-in. holes at *J* instead of ½-in. holes, as used with the plain sheaves.

If heavy work is to be done on the machine, it may be necessary to place stiffeners at *M* to support the ½-in. arbor as shown in the top view. If plain sheaves *K* are used separators *N* must be made to keep each in place. These may be made by boring a hole lengthwise through 1-in. pieces of wood and slipping them over the shaft. In either case, place washers at each side of the sheaves, as at *Y*.

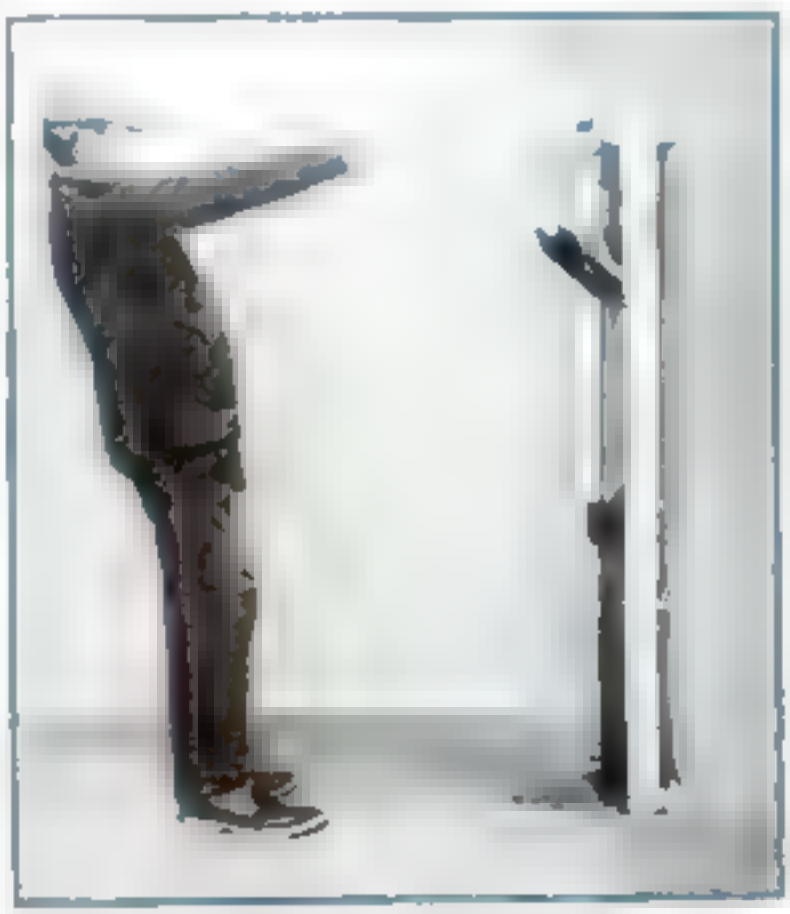
The seat top *O*, which is ¾ by 14 in. wide by 12 in. long, may be made of matched boards. Make two cleat rails O^1, 1 by 3¾ by 12¼ in. and shape them accurately to fit groove *B* as shown in the seat detail. The ball bearing skate rollers may be located by boring ¼-in. holes as at O^2, 1⅝ in. from the top edge to the center, with a ⅜-in. hole at O^3 to allow the nut to be placed on the end of the axle. Place a washer at O^2 to keep the wheels free of the cleats O^1.

As the roller may bruise the top of the side rails *A*, a ⅛ by ¾ in. iron track may be placed in a groove in the top of each side rail as at *S*, if desired, although hardwood alone will stand ordinary usage a long time. Assemble the seat with the braces at *P* as shown in the side view and use glue and nails liberally. A little trimming may be necessary to make the seat move freely, and the grooves in the two rails may be waxed.

Cut a piece of broomstick *Q* 15½ in. long as an anchorage for the rubber bands, and fasten it with three 3 10-in. stove bolts Q^1, nuts, and washers. Discarded inner tubes provide the rubber bands, which in the original machine were cut 11/16 in. wide and 30 in. long. With a 2-in. lap allowed for tying the ends, these make a band 14 in. long. A short harness strap snap was slipped over the rubber then the ends were adjusted for the 2-in. lap and held while the lap was stretched and a fishline was wound around and tied as sketched at *R*. When the tension was released, the lap held permanently.

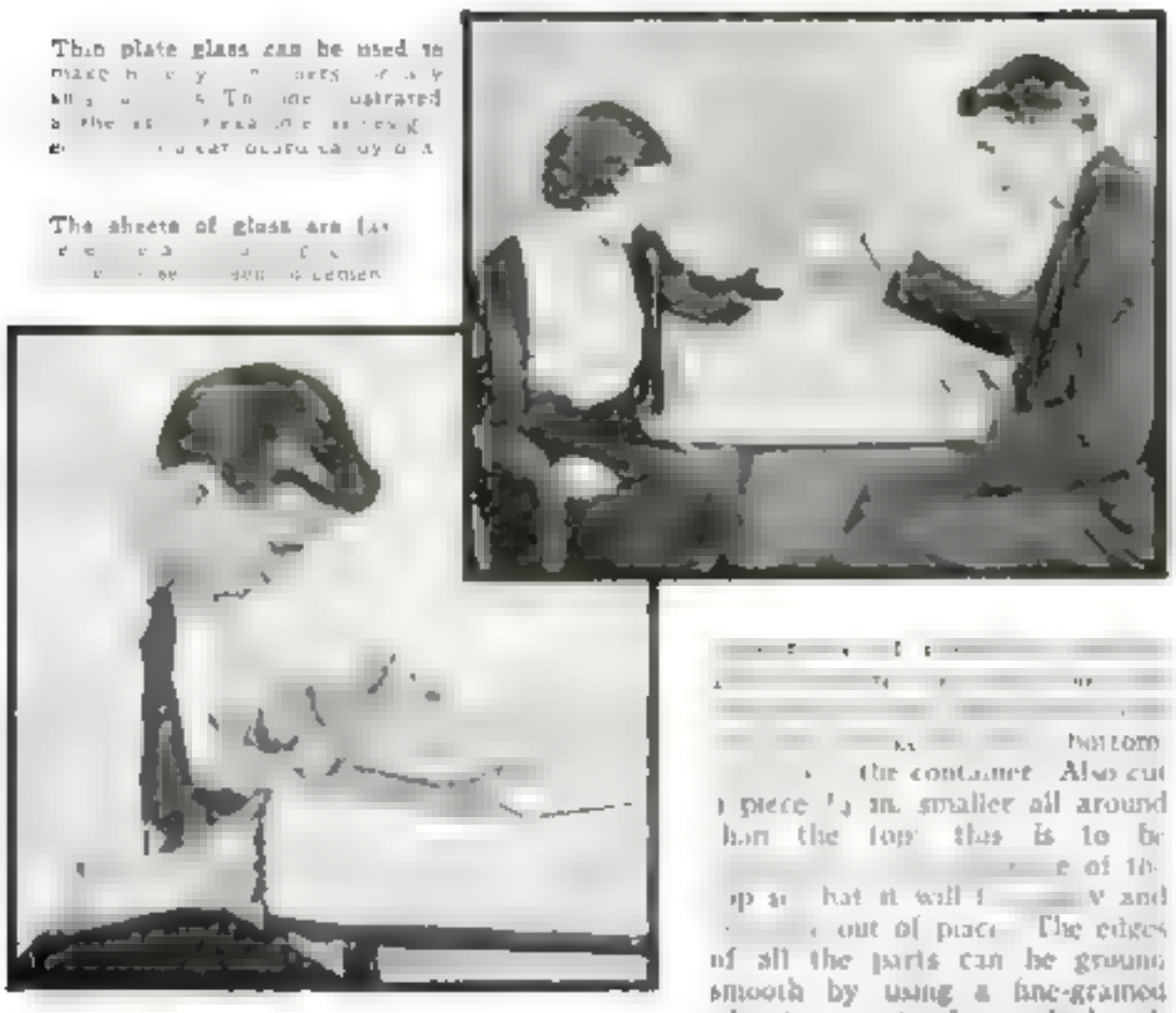
Six bands were made. Three were slipped over each end of the broomstick *Q* as at Q^2 and the bolts Q^1 tightened. The snaps of one, two, or three bands, as desired, were caught in a 1½-in. harness ring at *T* in the top and side views. A sash cord was fastened to the ring with half hitches and carried through ¾-in. holes *Z* bored in foot *C*, then over the sheaves to the grip *U*.

The grip was made by boring a ⅜-in. hole through a piece of broom handle 4 in. long, passing the cord through, and tying a bowline as sketched at *V*. A 2-in. No. 3 round-headed screw was driven about halfway in each rail as at *W* in the side view to hold the grips when not in use. Toe straps were fastened to the foot rests *F*, a hook and eye were used at *X* (side view) to hold the foot rest in place, the machine was given two coats of high-grade varnish, and it was ready for use.



Testing the machine as a wall exerciser. The tension is regulated easily by changing the size and number of bands.

CANDY BOX MADE OF CEMENTED GLASS



Thin plate glass can be used to make [illegible] The one illustrated [illegible]

The sheets of glass are [illegible]

[illegible] bottom [illegible] the container. Also cut [illegible] piece ¼ in. smaller all around [illegible] bom the top; this is to be [illegible] of the [illegible] that it will [illegible] and [illegible] out of place. The edges of all the parts can be ground smooth by using a fine-grained whetstone copiously supplied with water. Use a clear cellulose household cement for fastening the parts together. Although invisible, it will hold tenaciously being sufficiently flexible to stand considerable jarring. Cut off and file down the metal points of five glass pushpins of the size generally known as No. 2, and cement four of them to the bottom to act as feet and one to the top to serve as a knob. Glass boxes of other sizes may be made for holding handkerchiefs, gloves, stationery, cigars, cigarettes, and a variety of small articles. Novel glass containers such as these form highly acceptable gifts, and have the advantage of being inexpensive and easy to make.—KENNETH MURRAY

IF YOU wish a change from working in wood and metal, try using glass. Novelties made from it have a peculiarly modern look, they are so hard and smooth and brilliant. That is why they are being used more and more in smartly furnished homes. A simple yet novel project to begin with is a plain glass container such as might be used for candy. It should be of such a size that it will hold the particular kind of cardboard box in which you usually buy your candies. Then you need merely discard the lid and drop the box itself into the glass holder, the close-fitting cover of which will keep out the humid air that is so injurious to the

The flower adds a pleasing note of individuality.

TULIP DESIGN ADORNS DAINTY HAT STAND

TO MAKE the decorative little hat stand pictured, you will need a 5-in. disk cut from a 1 in. thick board, a 3-in. disk of ½-in. material, and a 7½-in. length of ½-in. wooden dowel. Round off the upper edges of each disk, bore a ½-in. hole through the center of the larger one, and bore nearly through the smaller one from its underside. For the tulip pattern, draw a rectangle 2 by 5 in. on a sheet of paper, divide the rectangle into 1-in. squares, and copy the lines of the pattern in the squares as shown. Cut out the pattern and mark around it on thin wood, then saw the shape from the wood and trim out the two openings. Round all the edges of this piece except the lower end, which should be mortised into the base. Plane a few shavings from the dowel stick as far up as necessary to make a flat surface for the tulip shape to rest against. Assemble the parts with glue. Enamel the rack itself brown and the tulip yellow, orange, or red, with rather dull green leaves.—HAZEL F. STOWALTER

METAL ROOSTERS DECORATE RIDGEPOLE

A DISTINCTIVE and amusing way to lend individuality to your house is to put metal silhouettes of roosters on the roof. These cut-outs can be used equally well on the garden fence or other places about the home. Aluminum, brass, copper, or cheap sheet iron may be used. In marking the design on the metal, take care that the legs are a little wider than in real life and reënforce them in the back if necessary, for they must stand the strain of high winds. Do the cutting with hammer and cold chisel on a block of lead or soft iron or on the end grain of a heavy block of wood. Touch up the rough spots with a file. The 1 in. wide strip of metal left at the bottom can be fastened to the roof in two ways. One is to cut vertical 1-in. slits at 2-in. intervals and bend the tabs alternately right and left to fit the pitch of the roof, screwing them securely in place. Another plan is to solder strap hinges to the lower edge of the silhouettes and then fasten the hinges to the roof with screws. If sheet aluminum is used, the hinges cannot be fastened to the uprights with ordinary solder. Before putting up the roosters, clean the metal thoroughly, being sure to remove all traces of dirt and oxide, and apply two coats of dull black paint.—DALE R. VAN HORN.

These rooster silhouettes break the straight line of the roof and form amusing ornaments.

"Anyone Can Make Good Photographic PRINTS"

says

FREDERICK D. RYDER, Jr.

To insure uniform results in printing place a box or other suitable marker in such a position that you can hold the frame exactly the same distance from the light each time

As the first step in making prints all the negatives should be sorted according to how light or dark they seem when held before a frosted lamp.

MANY readers have asked questions about photographic printing. One, for example, wants to know why his prints always look dull and gray. Another claims that he has had a lot of trouble with defective paper and "no-good" developer. Sometimes the sample prints accompanying the letters show one trouble, sometimes another. When the negatives from which the prints have been made also are inclosed, it is not hard to spot the difficulty, but it is not so easy when I have only the print to go by and there is no way of telling whether the negative is all right.

There really is no reason why any amateur should have any trouble at all in making good photo prints. The job calls for virtually no skill or manual dexterity. Furthermore, making prints is interesting because you can see the picture come out in the developer, and no dark room is needed.

Only the simplest apparatus is required. There is first the printing frame. This can be bought so cheaply that it hardly pays to make one. It is nothing but a rectangular wooden frame with a hinged, removable back. The film negative is placed with its shiny side toward the clear glass that fits the opening in the front of the frame, and the printing paper with its sensitive side against the negative. Then the back is clamped into place, and the frame is held to the light to make the exposure. If you want a white border around the print, cut yourself a mask of the proper shape and size from a piece of black paper, or purchase one of the self-masking printing frames.

The rest of the apparatus consists of three white enamel or glass trays, some tubes of M-Q developer or concentrated developing solution, some acid hypo, some acetic acid, and a supply of photo printing paper such as velox or some other developing-out paper.

The directions for mixing the developer are printed on the container, as is the proper temperature for use. The same applies to the packaged acid hypo.

The trays should be arranged in a row with the developing solution nearest to the end of the bench or table where you keep the package of paper and the printing frame. Next to that place a tray containing the "short-stop" solution. This consists of 1½ ounces of 28 percent acetic acid to 32 ounces of water. Of course you need only about 6 ounces of this solution in a 4 by 5 inch tray. Next to the short-stop solution place the tray with the fixing solution. Both the short-stop and the fixing solution can be used several times, but the developer should be mixed fresh.

It is possible to get along without the short-stop solution by using plain water instead, but I find it worth while as a safeguard against finger marks, uneven developing, and so on.

No dark room is needed. Velox and similar papers can be handled by subdued electric light, which means 10 feet or more from an ordinary 40-watt bulb. Some sort of a shield should be put up—a sheet of corrugated cardboard will do—to keep the direct rays of light from striking the trays or the place where you load the printing frame.

Printing is the point in photography where the minor errors in exposing and developing the negative can be corrected. This is, however, only possible if you have on hand all four grades of printing

Send in your BEST PRINT... It May Win $10

FOR the most photographically perfect picture submitted on or before November 2, 1931, POPULAR SCIENCE MONTHLY will pay $10. It may be of any subject, but must be taken during the months of September and October, 1931, by an amateur and printed by himself. Any type of camera may be used, and the developing may be done by a professional. Mail both print and negative to Photographic Editor not later than November 2, and mark your entry "October Photo Contest." If you wish the print and negative returned, send a self-addressed, stamped envelope with entry.

Winner of First Contest

Arthur A. Annis, of Rockford, Ill., submitted the best picture in the photographic contest announced at the beginning of this series of articles (P.S.M., June 31, p. 84) and won the $10 prize. The following are awarded honorable mention: W. W. Behrend, Los Angeles, Calif.; Richard Bonnamy, Elmhurst, N. Y.; A. L. Fischer, Collingswood, N. J.; George C. Friend, Roanoke, Va.; Jane Keen, Henry S. D., Marvin McKimbrough, Tallassee, Ala., Bert Leach, Portsmouth, Ohio; Albert Rubin, Charlottesville, Va., Oscar Wellander, Roslyn, N. Y., and Wilk M. Works, Vevay, Ind. The winner of the July contest will be announced next month.

paper, ranging from No. 1, which will give a good print from a negative that has been taken in a harsh light or is overdeveloped, through No. 2, which fits average negatives, to Nos. 3 and 4, which give respectively more contrast and still more contrast. Either No. 3 or No. 4 will give a good snappy print from a weak, flat negative that has been, for example slightly overexposed and underdeveloped.

Many beginners are tempted to get along with only the No. 2 paper. I strongly advise purchasing at least one package of each kind right at the start. Later on your results will indicate which grades you can do without.

Assuming that you have everything ready, the first step is to test the safety of your lighting arrangement. Take a sheet of No. 1 paper and lay it sensitive side up, on the table or bench next to the developing tray. Cover half of it with a book and let it stay there with the printing light turned on for two minutes. Then develop it, face down, for 45 seconds, transfer to the short-stop tray for 5 or 10 seconds, and finally put it in the fixing tray. If both halves of the sheet are clear white, everything is all right. If the exposed half shows a shade of gray move the light farther away or get better shading with a bigger piece of cardboard.

Before you make a print, sort all your negatives according to how light or dark they seem when held in front of a frosted electric light bulb. Take either the lightest or darkest negative, place it in the printing frame shiny side toward the glass, and lay a piece of paper against it with the sensitive side toward the negative. Glossy paper is slightly shiny on the sensitive side. If in doubt bite the corner of the sheet with the teeth, and the side that sticks to your teeth is the sensitive side.

Place a box or some other marker so that you can hold the printing frame exactly the same distance from the light each time, as shown in the upper photograph on page 78. Try 10 seconds for a starter and develop the paper for exactly 45 seconds. If the exposure has been too long, the print will be too dark and you will have to try again, cutting down the time by a third. Be sure to develop at least 45 seconds. Many beginners get flat and muddy prints because they expose too long and then cut the time of development in an attempt to save the print. If the print is too harsh—all white or black—try a lower number paper. If it is too soft and gray all over, try a higher number paper.

As soon as you get a satisfactory print mark the correct exposure time and the grade of paper on the edge of the film. These figures will save paper if you have additional prints to make at a later date, and the marked negatives also serve, by comparison, to determine the proper time and paper grade for succeeding negatives.

If you underexpose a print so that the picture does not appear sufficiently dark at the end of 45 seconds, continued "cooking" in the developer will do no good and will result only in staining the print unless the developer is nearly exhausted, in which case the development time may have to be as much as a minute and a half.

The rule to use fresh developer each time holds good except in cases where you mix a fresh batch and only develop two or three prints. In that case the developer can be poured into a bottle just large enough so that it will completely fill it, and if it is well corked it can be used again as long as a week or two later. The fixing and short-stop solutions can be kept in bottles when not in use, and no corks are necessary if they are set away where there is little dust. Both solutions should be discarded when they become discolored.

Be sure to leave the prints in the fixing bath for at least 15 minutes, stirring them occasionally to let the fixing solution act evenly, then wash in running water for an hour, also with an occasional stir.

Cleanliness is vitally important in all photographic processes and especially in printing. Never let even so much as a drop of either the short-stop or the fixing solutions get into the developer tray, and never use the developer tray for anything except developer. Each time you make a print, develop it and put it in the fixing solution after a dip in the short-stop, then be sure to wash your hands in running water and dry them on a towel before you take out the paper for the next print. If you don't do this, fixing solution will be carried by your hands back into the developer and completely spoil it.

It is a good idea to keep the developer tray at least a foot or two away from the other two so that there will be no chance for short-stop or fixing solutions to splash into the developer.

Another photographic article by Mr. Ryder will appear in the November issue. Meanwhile, if you wish his personal assistance in improving your camera work, send him some of your prints with the negatives from which they have been made and enclose a self-addressed, stamped envelope. He will be glad to criticize the prints and to answer any questions you wish to ask about photographic matters.

SHEET METAL LANTERN IN JAPANESE STYLE

TWO experts, an art teacher and a metal craft instructor of long experience, worked together in designing and constructing the electric lantern illustrated. This accounts for its superior design and excellent proportions. It is a beautiful piece whether finished in sheet iron or copper.

The design represents a typical Japanese landscape—a cypress tree, the great volcano Fujiyama and a lake. Copy the design full size on heavy paper or cardboard and cut out the open spaces with a sharp knife. Then use this pattern for outlining each side on the sheet metal with soft pencil or crayon. The heavier the gage of the metal, the better; 20-gage sheet iron was used for the original lantern. Be sure to leave a tab or flange at the top of each sidepiece, it will later serve a double purpose for a part of it is bent in so that the roof can be riveted to it, and part is bent down to hold the glass in place. After the design has been cut out with a cold chisel and the edges smoothed with files, the metal should be "raised" considerably with a small ball pein hammer, and a few grooves added to indicate the tree trunk and foliage. The sides are fastened together with angle strips, secured with four soft iron rivets in each edge.

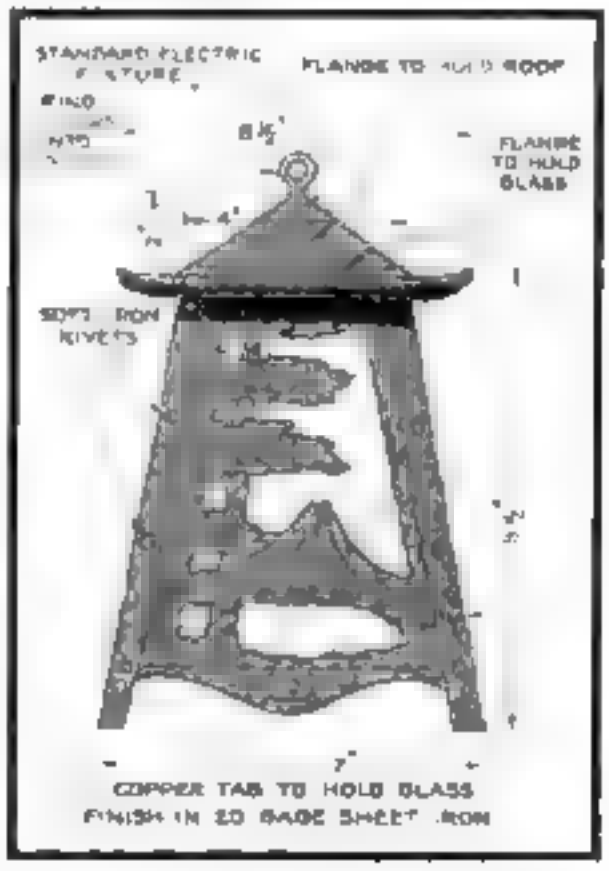
The roof is a pyramid laid out in one piece with a riveted joint. The overhanging edges are "raised" and curved as shown with the ball end of the hammer head. It is best to make a complete model of the roof in stiff paper and bend up the edges with the fingers to get the effect before attempting the work in metal.

To have the proper artistic effect, the lantern should be indented with hundreds of hammer marks. The simplest finish is to clean the metal well with fine emery cloth and then wipe all over with waste dipped in linseed oil. Allow the oil to dry thoroughly before inserting the glass.

The glass is a matter of choice, as there are many beautiful textures available. I suggest an amber color with an antique finish—that is, a glass full of bubbles.

A copper tab at the bottom of each side will hold the glass.—J. R. Utsinger.

In wiring lanterns, especially if they are to be on open porches and exposed to the weather, it is important to observe the requirements of the local electrical inspector (see P.S.M., Aug. '31, p.90).



This CARD TABLE *Wears Forever*

The frame is of iron but very simple to construct, and the top is durably covered with tile-like linoleum

By WALTER E. BURTON

This attractive "tile-topped" card table is just the thing for use in your sun parlor.

THIS card table, which is particularly suitable for the porch, terrace, or sun room, wears like iron because it is made of iron—that is, with the exception of the "tile" top of embossed linoleum on a backing of plywood. And being of iron, the table is more solid and durable than if it were of wood, a feature that overshadows the somewhat greater weight.

The total cost of the materials ought not to exceed two or three dollars. This depends largely on what you must pay for the linoleum. Sometimes it is necessary to buy twice as much as you need because stores are unwilling to cut corners from a roll, but it usually is possible to get a remnant for a fraction of the regular price.

Make the frame for the top from ¾ by ¾ in. or 1 by 1 in. angle iron, cutting the corners on a 45° miter in a simple miter box like that shown in one of the photographs. Each of the sidepieces is 28 in. long measured along the outside edge.

Corner braces measuring about ⅝ by 2½ in. on a face are used to fasten the frame together. By means of a C-clamp, fasten the braces temporarily in place, one at a time, and drill the ¼-in. rivet holes through brace and frame at once. Then insert ¼-in. soft iron, roundhead rivets into each of the holes farthest from the corners, slip a burr over each rivet, and upset the ends with a ball pein hammer. This will hold the frame in shape, so omit the remaining rivets for the time being.

Obtain or make four small right-angle braces, each leg being about ½ in. wide and 1 in. long. Drill these with a ¼-in. drill so that, when a brace is fastened in one corner of the frame by a rivet through one of the free holes as shown in photograph at top left corner of page 81, the remaining hole will be in line with that drilled through the projecting leg of the angle piece. This is to insure the solid anchoring of the leg. You can make the small angle pieces by sawing them in sections from a piece of ¾ by 1 in. angle iron.

The curves of the bar iron legs produce a pleasing diversion from strait-line severity. Angle iron forms the top frame.

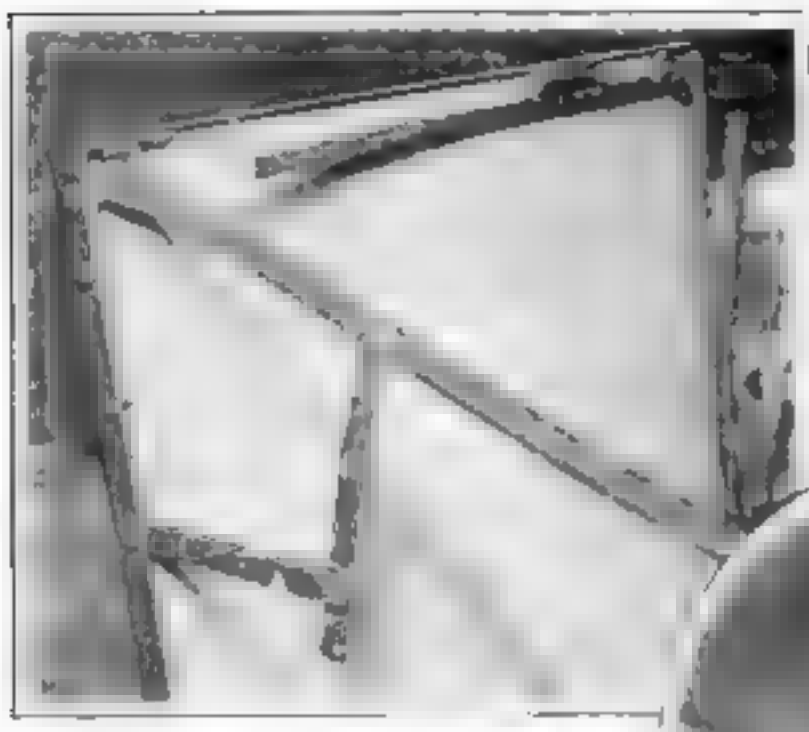
Each of the legs is a section of ¾ by ¾ in. bar iron cut to a length of 27 in. Drill a ¼ in. hole through each leg, starting the drill at a point 2 in. from one end. Round this end with a file. Then at a point about 2 in. from the same end, bend the iron to one side so that the center of the hole is approximately in line with one side of the leg. This is to permit the leg to fold against the underside of the top. You can leave the remainder of the leg straight, or bend it in a pleasing curve like that shown.

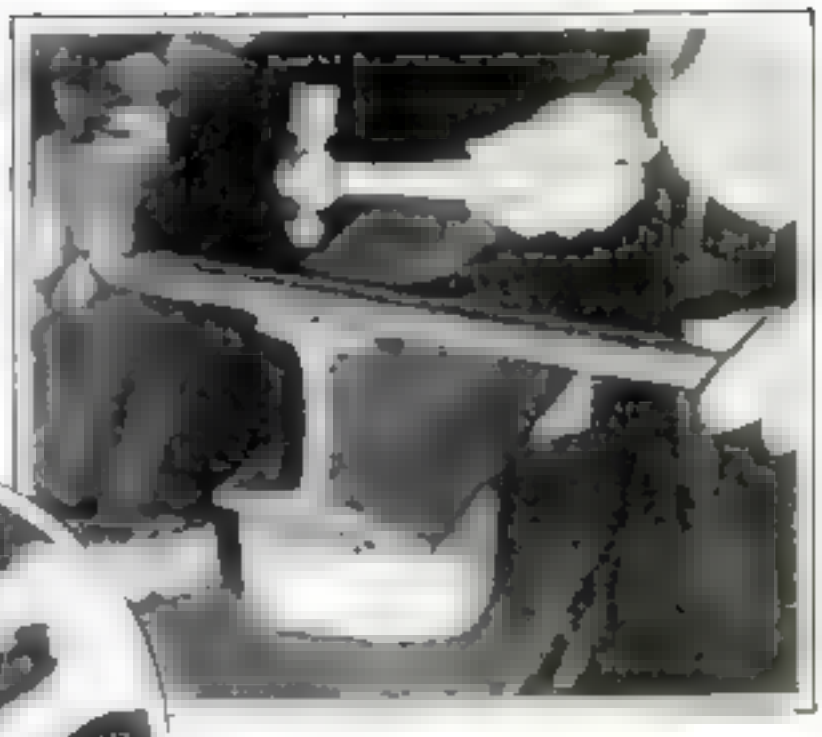
To hold the legs rigidly open yet permit their folding, a hinged brace resembling a desk slide is used. You can obtain slides at a hardware store, but these usually are of brass or nickel finish that does not harmonize with the iron framework. It is better to construct sturdy braces as illustrated from 3/16 by ⅜ in. band iron and iron rivets. Drill both leg and frame to receive the rivets for holding the brace in place, and make certain that the distance from the long rivet that forms the leg bearing to each rivet of the brace is the same. In attaching a leg, insert a long (2-in.) rivet through the frame hole, slip over the rivet either several rivet burrs, a short length of metal tubing, or even a section of coil spring to serve as a spacer, follow this by the leg and another spacer, and finally flatten the end of the rivet. The leg should be rigid, yet fold or unfold smoothly.

For the top or playing surface, obtain a square of inlaid linoleum having a raised tile design in whatever colors you prefer. Genuine tile would make the table unnecessarily heavy. Cut portions from the corners so that the linoleum will fit around the corner braces and the folding leg braces, outside the angle iron frame. Then polish the surface of the linoleum with two applications of floor or automobile wax.

Cut a piece of ¼ in. thick veneered panelling to form a backing for the linoleum. It will be necessary to provide

An improvised wooden miter box simplifies the cutting of the sections of angle iron needed for the top frame.

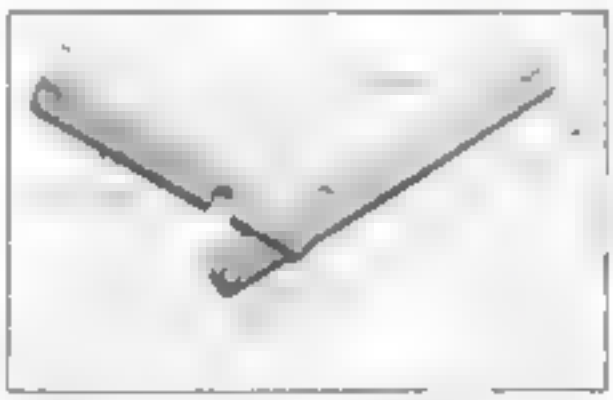




The corner braces are clamped to the frame pieces and the holes drilled through both

several pre holes of fastening this backing in place. Perhaps the best is to cut strips of rich or other tough wood or of metal of such size that they will lie along the edges of the plywood back yet will project below the table edge, then fasten these by means of wood screws or iron rivets passing through drilled holes in the frame. Other expedients are to use sheet-metal lugs riveted in place or even long rivets alone anchored in the frame holes by means of two or three deep punch marks around them.

The finishing of the iron parts preferably should be settled before any of the sections are fastened together. The iron can be cleaned thoroughly, all sharp projections, of course, being removed, and given two or more coats of lacquer in suitable colors. But since soft iron is used, you can easily produce a wrought-iron appearance, enhancing the effect



Detail of one of the four folding brackets for the legs, with the important dimensions

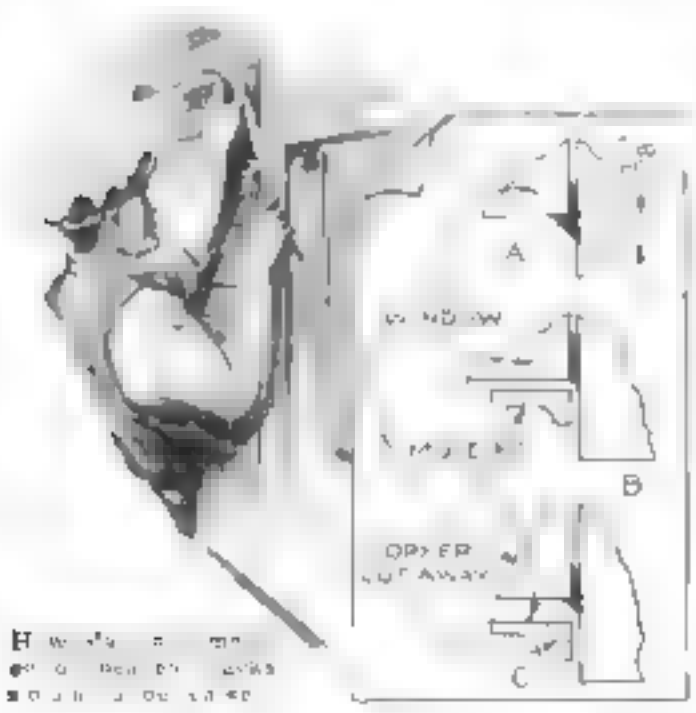
created by the linoleum top, provided you have no objections to an imitation of this.

The wrought iron finish is obtained by marking the exposed surfaces of the frame sections and legs with the ball end of a machinist's hammer. Make the depressions rose tapered and scatter a few along the edges, just as if you had hammered the piece to shape. Afterwards it probably will be necessary to straighten the pieces, because the hammering causes them to warp. With fine sandpaper or emery cloth, bring out the highlights a bit, and apply two coats of the same wax used for the linoleum top. You had better leave the hinged braces plain, as they work more smoothly without hammer marks, but give them the wax treatment.

You now have a card table that will not collapse in the middle of a game and one that thrives on hard knocks. If you spill something that dissolves the linoleum on the table top, simply remove a few rivets and the plywood backing, and put in a new piece.

Tips on Calking Outside Cracks

MUCH of the work done by house owners in calking cracks around window and door frames is only short lived. This trouble is caused by the fact that the calking compound usually dries out but the fault lies in the method of application rather than in the calking compound. In most cases drying out is due to the fact that the raw wood, brick, stone or cement in the cracks absorbs the oil in the compound. In other cases, the body of the calked joint is too small. If a heavy coat of paint is applied to the joints before the calking compound is used, most of the oil absorption trouble will be overcome. In the case where a filler such as rags, wood, or paper is used, it is well to treat it also to prevent undue absorption. Oakum is more convenient to use because ordinarily it is sold ready to apply.



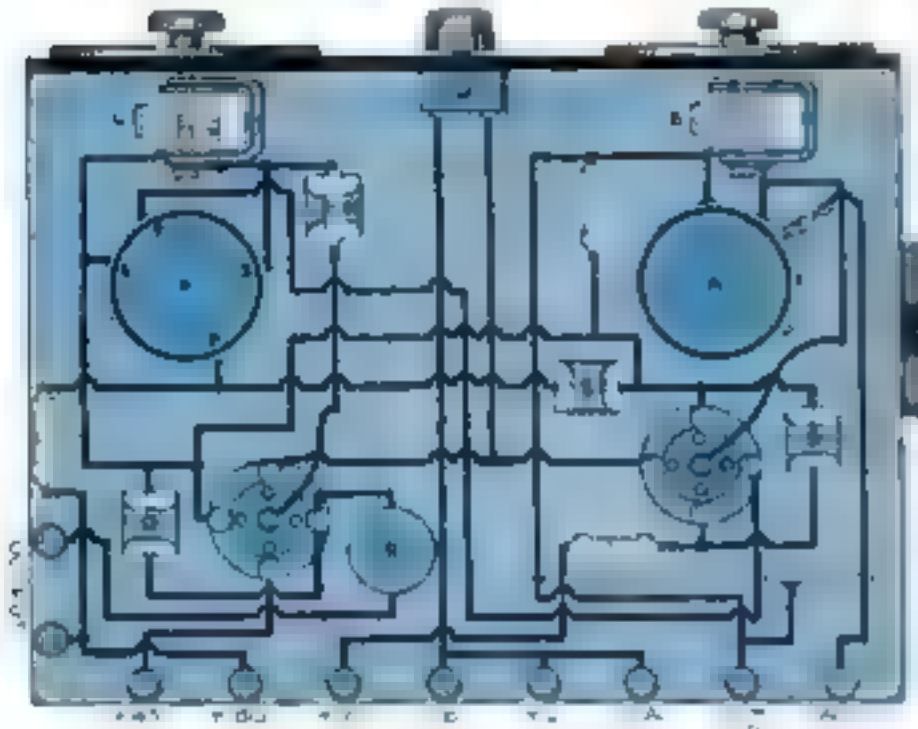
Where you have a small, narrow or shallow opening, it is best to lay a ¼-in. fillet across the joint as shown at *A*, to provide sufficient material to form a tough outer hide or skin and still have body enough to keep from cracking up and eventually falling out of the crack.

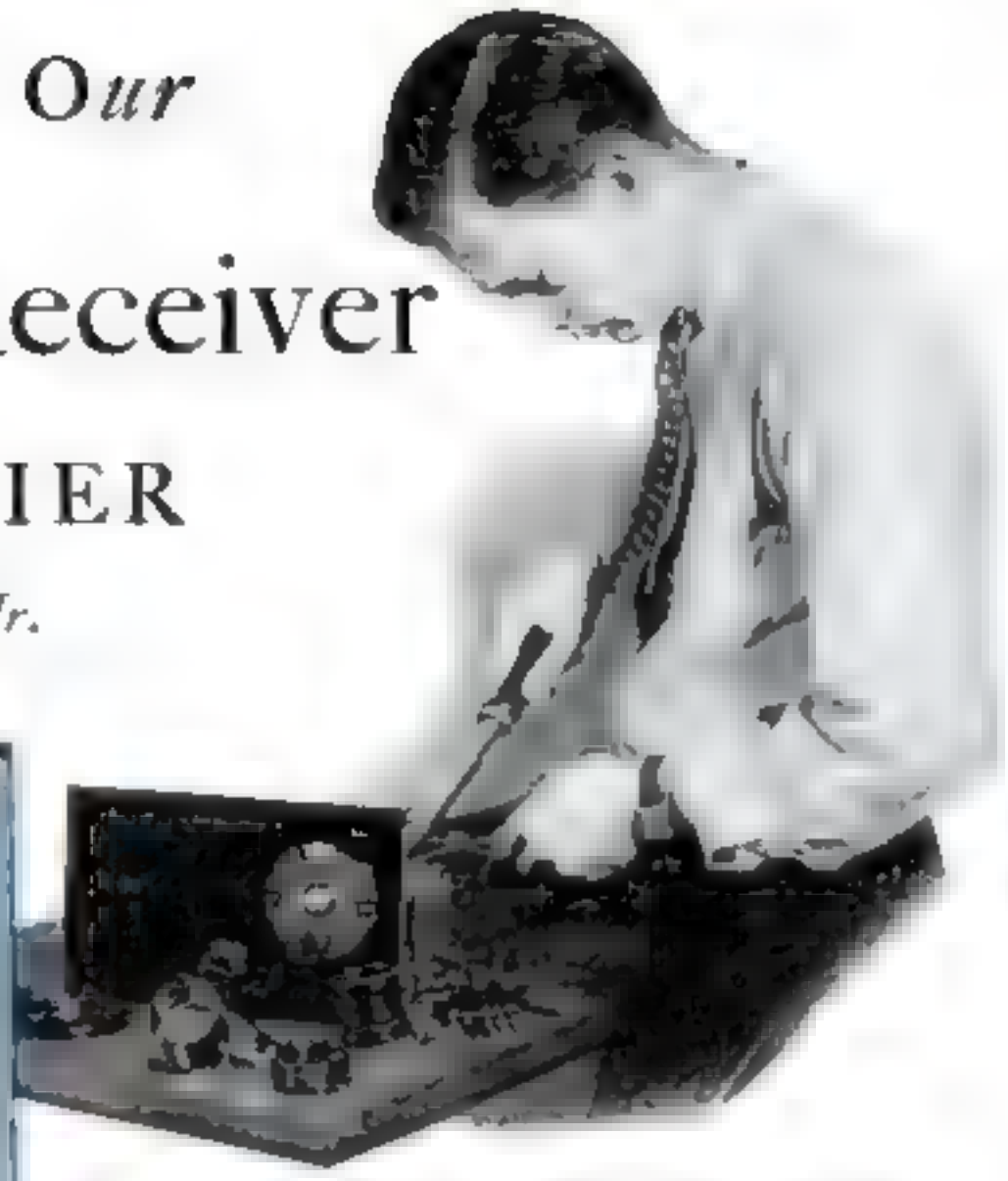
In many cases the window and door frames are fitted with brick molds, calking strips, or fancy beads. These pieces can be removed and the cracks or crevices packed as at *B* with oakum, mineral wool, or any of the other materials made for this purpose. When the crevice is very narrow you can cut off from ¾ to ¾ in. of the inside corner of the strip before renailing or screwing it into place, as at *C*. It will usually be necessary in such cases to tack the material up in the opening, rather than try to hold it in place while putting back the wooden molding or bead.

If you have some calking compound left over, do not forget the cracks between the brick porch columns and the porch screen framework, the crevice between an inbuilt tub and the wall, and other similar openings. Fill them in, let the compound dry until a tough skin has formed, and then paint over it. This method has been used successfully even in setting joints in floor lights where tar would not stay and putty always cracked out.—H. M. De Voss

We Assemble Our Television Receiver and AMPLIFIER

By George H. Waltz, Jr.





The author at work soldering a connection on his two-tube television receiver. A tapped antenna coil was used instead of the interchangeable coils shown on the bench directly in front of the set. *At left*, A picture diagram of the short wave receiver unit

AFTER driling the scanning disk last month, George Waltz set about assembling his television receiver and amplifier, and in this informative article he tells you how he and his friend Don Marshall did the work. You may not wish to build a "vision" receiver, but if you're at all mechanically minded you'll want to know what makes a television set "tick"

"HERE are the parts I bought for my short wave television receiver and amplifier." I said as I led Don Marshall over to one corner of my basement shop and pointed to the variable condensers, sockets, and other miscellaneous parts piled up on my woodworking bench.

"You know when we finished that scanning disk last month you promised to help me with the receiver."

Don, who is a radio expert of long experience and also an experimenter in television, picked up the three-tube resistance coupled amplifier block that had cost $2.95. "Not a bad unit," he remarked. "Have you decided on the hook-up you're going to use?"

"That's where you come in, Don. I've tried to figure out a circuit, but all the diagrams I've seen are Greek to me so I'm hoping I can take advantage of your short wave experience. The man at the radio store said that with an amplifier unit like that all I'd need would be a simple one-tube short wave receiver."

"Well," Don replied, "most television receivers have one or two stages of tuned radio-frequency amplification. You see the television band is so narrow that you can't get much selectivity without them. It's a real job, though, to assemble two R.-F. stages and shield them properly, so we'll try one stage first. It ought to work on the local stuff anyway and then later on if you want we can rebuild the set to accommodate the second stage."

"Anything you say goes, Don, but how are we going to test the receiver when we finish it?" I asked. "You know I haven't assembled the scanner yet."

Don grinned. "That's the simplest part of the whole problem. All we have to do is connect the loudspeaker and then tune in on some local television station. If we get an ear-splitting buzz-saw wail that's loud enough to be hard on the ears we'll know that the set's O. K., as far as intensity of signal is concerned. If we don't, we'll have to look up a better circuit."

"Then as I understand it," I said, "we're going to use a two-tube short wave receiver having one stage of tuned radio-frequency amplification and hook it into that resistance coupled amplifier unit."

Don agreed with a nod as he began sketching out a wiring diagram. While he was busy figuring the values for the various resistances and coils for the two-tube receiver, I cleared the top of my bench, got out my soldering iron, solder, pliers, and screw driver and prepared to go to work.

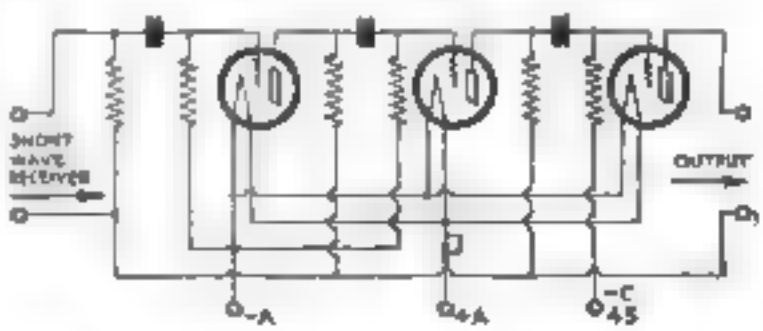
"I'll tell you what we'll do," Don called out, looking up from the diagram. "We'll make this a battery operated set to start with and then if it's satisfactory we can change over to A. C. operation later on. You have a storage battery, haven't you?"

"Sure," I replied.

When Don had finished the wiring diagram, he pulled up another chair and motioned for me to sit down beside him. "In order to make this diagram easy to follow," he explained, "I've placed a letter on each part. This coil, which I have marked *A*, is the antenna coil. It should be wound with number twenty-two double-cotton-covered wire and should have taps taken off at the fifth, tenth, and fifteenth turns."

"What'll we use," I interrupted, "a switch and three taps?"

"No," Don replied, "we don't have to go to that much trouble. We can have loops at the fifth, tenth, and fifteenth turns and then by changing an ordinary



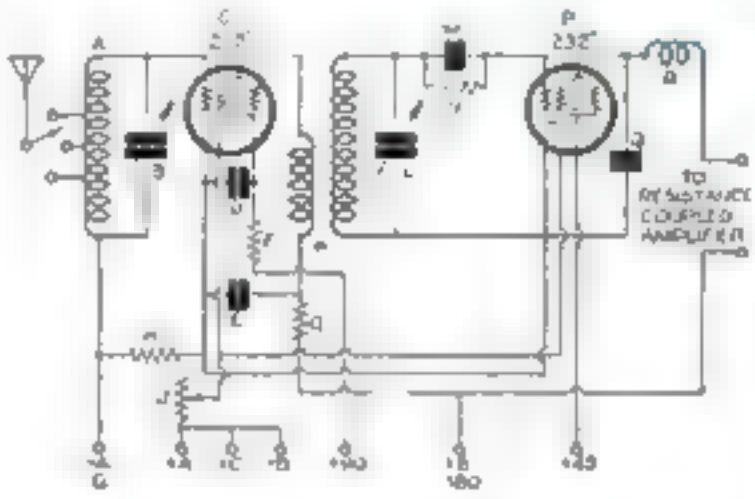
Wiring diagram for a three-stage resistance coupled amplifier. Complete units may be purchased, if desired.

Complete Diagrams for "Vision" Sets Run by Either Battery or Alternating Current

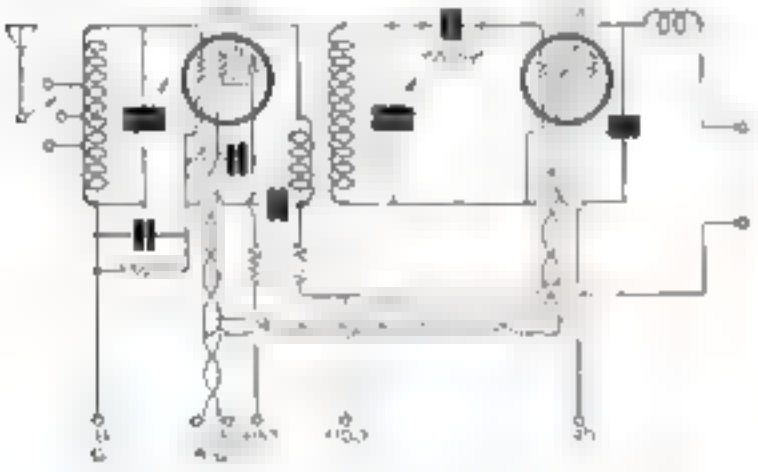
spring clip from one loop to the other we can get the adjustment we desire Now to go ahead," he continued, tracing the diagram with the point of his pencil "*B* is a variable condenser having a maximum capacity of .00014 microfarads, and *C* is a type two-thirty-two tube and socket. These resistances, which I have marked *F* and *G*, are a thousand ohms each, and *H* is twenty-five ohms. This twenty-five ohm resistance, which is connected in the negative side of the 'A' battery circuit causes a voltage drop of about three volts and brings the six volts of the battery down to less than three volts for the tubes. If we were using two dry cells of one and a half volts each instead of the six-volt storage battery, we could omit that resistance because the voltage would be just right. The condensers *D* and *E* are .01 to .1 microfarads. The rheostat *J* should go from zero to fifty ohms and serves to regulate the filament voltage The part I've designated with the letter *K* is the radio-frequency coil and should be wound with number twenty-two double-cotton-covered wire The secondary of this coil should have forty-eight turns, and the primary, which can be wound over the lower part of the secondary, should have twenty turns of the same size or smaller wire."

"Can I buy a coil like that?" I asked

"Oh, I suppose you can," Don replied, "but why bother about that? We can wind one in less time than it would take to buy it. I think I have some number twenty-two wire at home. I'll go over later and see, but first let's finish going over this circuit. The variable condenser *L*," he resumed, "is the same as condenser *B* and is connected across the the secondary coil. Connected in

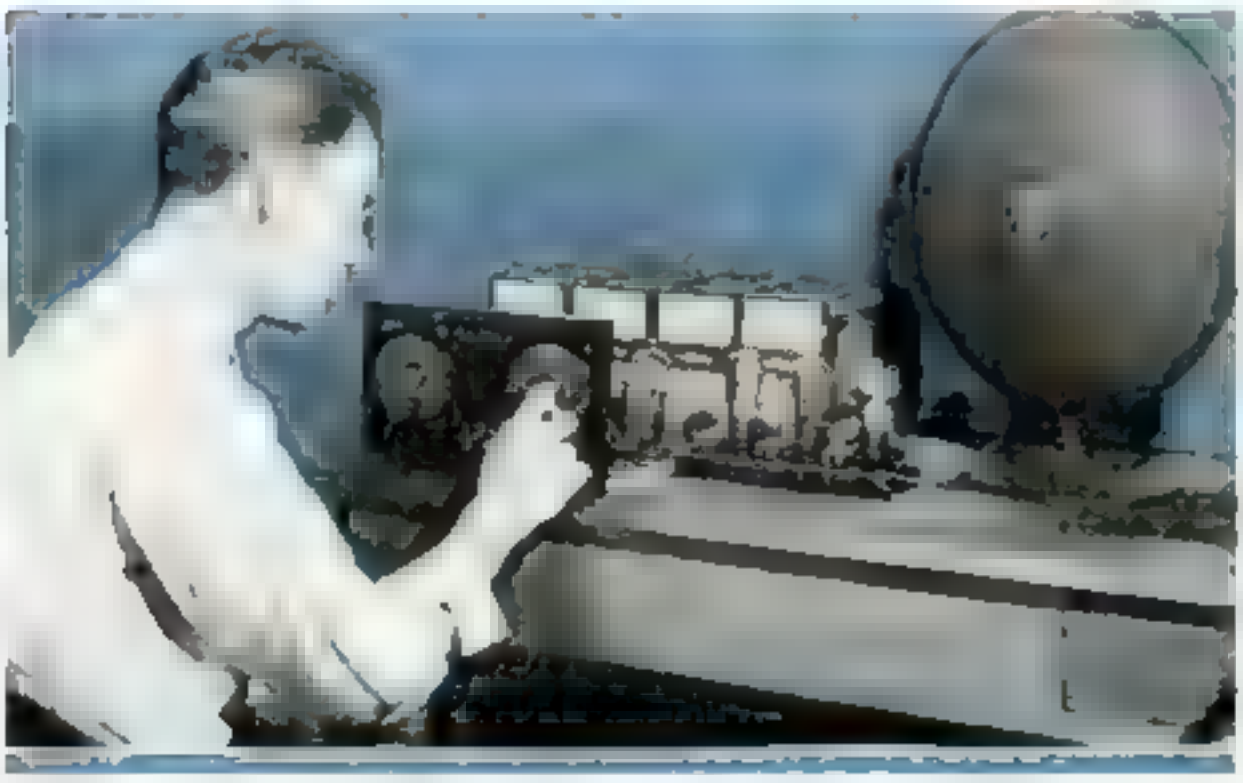


Battery hook-up for the two-tube short wave television set having one stage of radio-frequency amplification.



The short wave hook-up wired for A. C. operation. In this case, type 224 tubes and sockets are used.

parallel into the wire which leads from the secondary of the coil to the control grid of the tube are a .0001-microfarad condenser *M* and a half-megohm resistance *N*. Part *P* is the detector, which is another type two-thirty-two tube. *R* is a radio frequency choke, one end of which forms one of the output terminals to the resistance coupled amplifier; the other side of the output comes from the resistance *G* That finishes the short wave re-



When we had finished assembling the short wave receiver, Don connected a speaker to the output of the resistance coupled amplifier and we tested the hook-up for intensity of signal

To cut down regeneration and interference, the radio-frequency stage was placed in an aluminum shield.

ceiver. With that amplifier unit we won't have to worry about the amplifier circuit, but I've drawn one up for you so you can see what it looks like on paper

"There's just one more thing about this circuit," Don continued when I had finished studying the diagram. "In order to reduce regeneration and interference to a minimum we'll put the antenna coil *A*, the condenser *B*, socket and tube *C*, condensers *D* and *E*, and resistances *F* and *H* in an aluminum shielding can. If we find, when we start assembling the set, that it is more convenient, we can put the rheostat *J* in the can also, but it's not necessary."

"I'll have to visit the radio store again and pick up one of those shields, but before I go I think I'll check up on the other parts and see if I've all I need "

Come to think of it," Don replied as he put on his coat, "I believe I've got just the size shield we'll need. I'll go home and look around for it."

Don returned soon with a spool of number twenty-two wire and a rectangular shielding can. Working together, it didn't take us long to assemble the short wave receiver and connect it to the amplifier

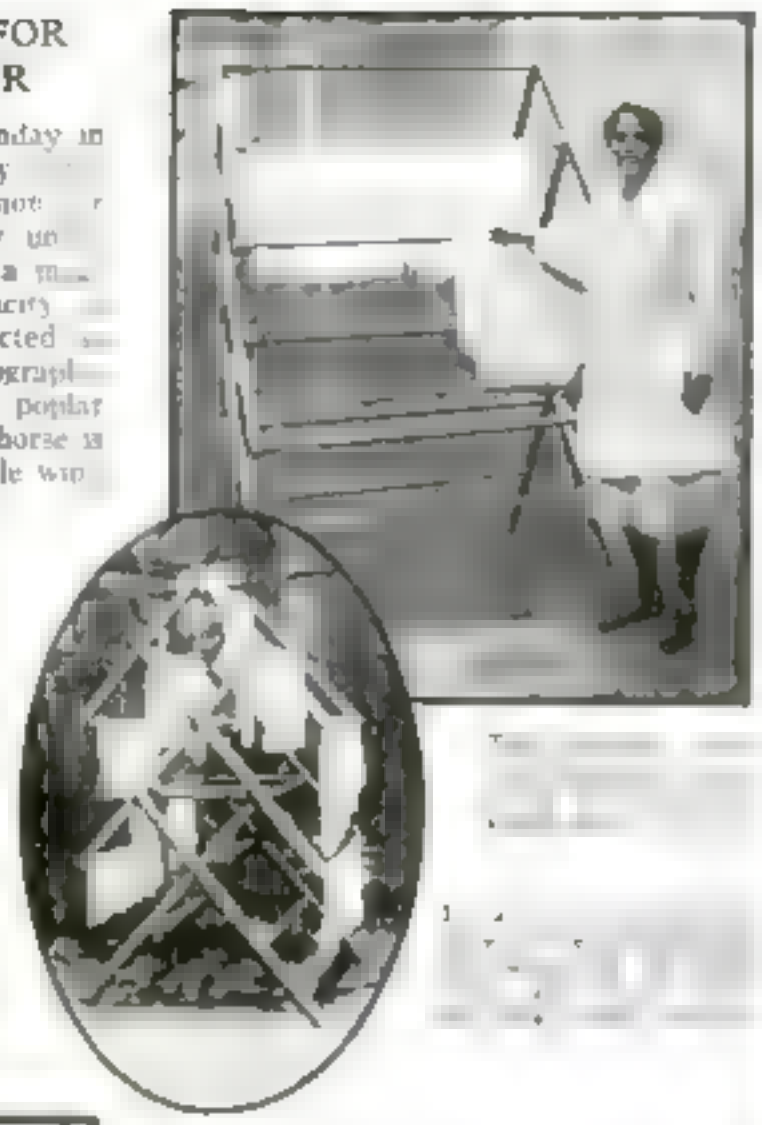
"Now comes the test," Don said hopefully as he hooked up the loudspeaker into the output of the amplifier

As Don turned the dials on the receiver, I crossed all my fingers and hoped for the best. Almost immediately he succeeded in picking up the peculiar television signal of some station and after making a few adjustments brought the signal in loud enough to satisfy his critical ear "This circuit," he said, "isn't the best possible for the job, but it'll work fine for the local stations and when you get better acquainted with the circuit we can rip it apart and rebuild it with two radio-frequency stages. The best thing to do now is assemble your scanner so we can try the two units out together. The proof of this puddin' is in the seeing."

Next month, George Waltz will tell you how he went about assembling the scanner and will report on the quality of the image he obtained

BIG CLOTHESHORSE FOR SHOWERY WEATHER

As it seems to rain every Monday in the old city by the sea where my [illegible] is, it is necessary to make provision [illegible] moving the weekly wash quickly [illegible] shelter or for drying indoors, so a [illegible] nified clotheshorse equal in capacity [illegible] 50 ft. of clothesline was constructed [illegible] shown in the accompanying photograph. The materials used were oak and poplar scraps found in the garage. The horse is strong enough to stand considerable wind and weather, and it folds up flat for storage. It is much more practical than the flimsy ones sold in department stores. Eight of the arms are ⅞ by 1½ by 50 in. oak, and four are ⅞ by 1½ by 34 in. The thirteen rods are ¾ in. diameter poplar, 50 in. long. There are two poplar spacing pieces ¾ by 1½ by 18 in., with semicircular notches at each end to drop over the rods as shown. The illustrations show its construction. The only problem was where to bore the holes for the crossing of the arms; they are spaced apart a distance equal to one third the arms.—H. JERVEY



TRUCK TIRE CONVERTED INTO SAFE SWING

Swings made from auto tires are quite common, but illustrated below is a novel improvement in respect to both safety and comfort. Any truck tire measuring 7 in. or more in cross section may be used. A good section of the tread is marked out, then the casing is cut away from the beads for most of the distance around, leaving intact a strip of the sound tread only about 21 in. long. This is what is to form the seat of the swing. The remainder of the tread is cut free and thrown away. The swing is then hung from a tree limb or other support. A single rope or chain will serve if the swing is attached so it by means of two short chains or ropes held apart by a wooden spreader as shown. It will be found that the beads are stiff enough to remain in almost a true circle even when two youngsters are in the swing at the same time. If desired, a chain or rope can be taken from each bead straight up to the limb.—JACK ROON.

This unusually comfortable swing, big enough for two children, is made from a truck tire.

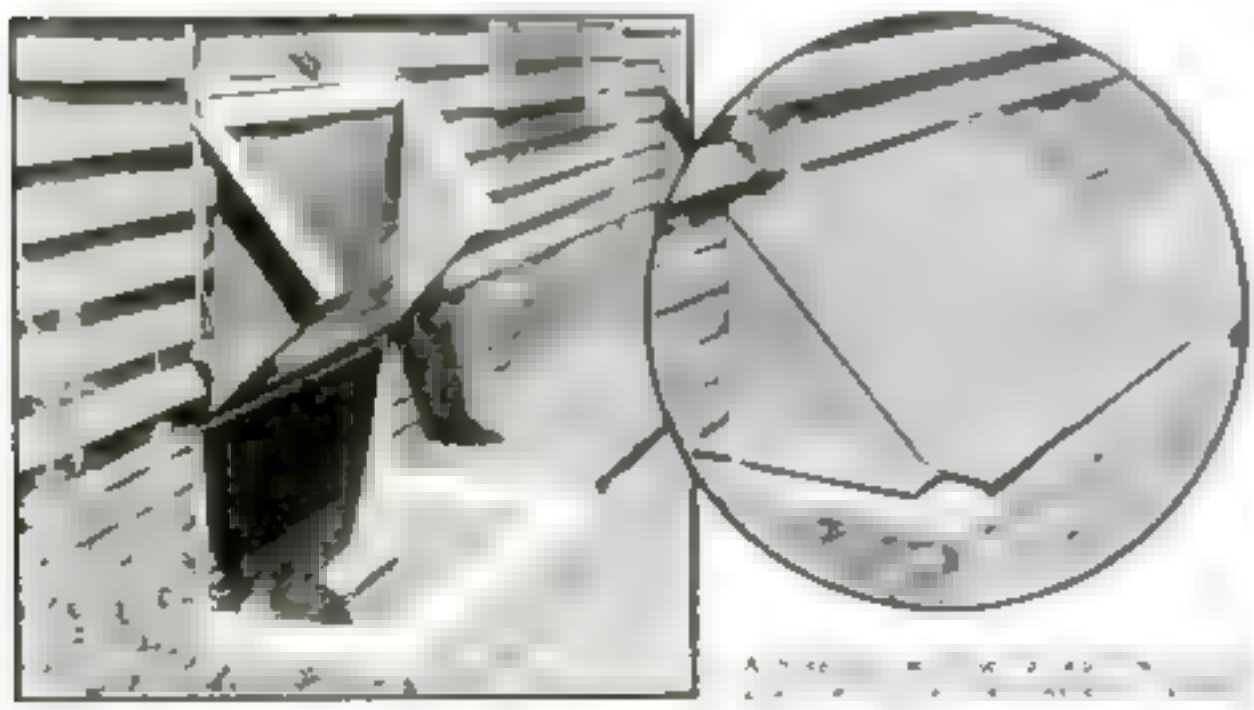
If celluloid protectors are used under them, paper clips will not cause damage to photos

PAPER CLIP PROTECTORS

PHOTOGRAPHS and other inclosures commonly attached to letters and documents with paper clips are frequently indented or defaced by the wire. An excellent way to prevent this is to use celluloid protectors under the clips as illustrated. Get a sheet of old celluloid and cut it into convenient strips about ½ in. wide and 2 in. long, and bend each of these in half before slipping it over the papers. Then apply the clip, which can do no damage even if it has a grip like a blacksmith's vise.—F. H.

RAIN GUARDS KEEP BASEMENT DRY

"AIRWAYS" or concrete curbings around basement windows of the type illustrated below often allow a flood of water to enter the cellar during violent rainstorms. In such cases a good plan is to make a galvanized iron rain guard for each window, or prepare a dimensioned sketch and have a tinsmith do the work. When a storm comes up, the guards are dropped so as to keep the rain from the pits. If the lower edges are bent slightly down, no water will run in. A wood button fastened to the house holds the guard up in bright weather.—J. R.

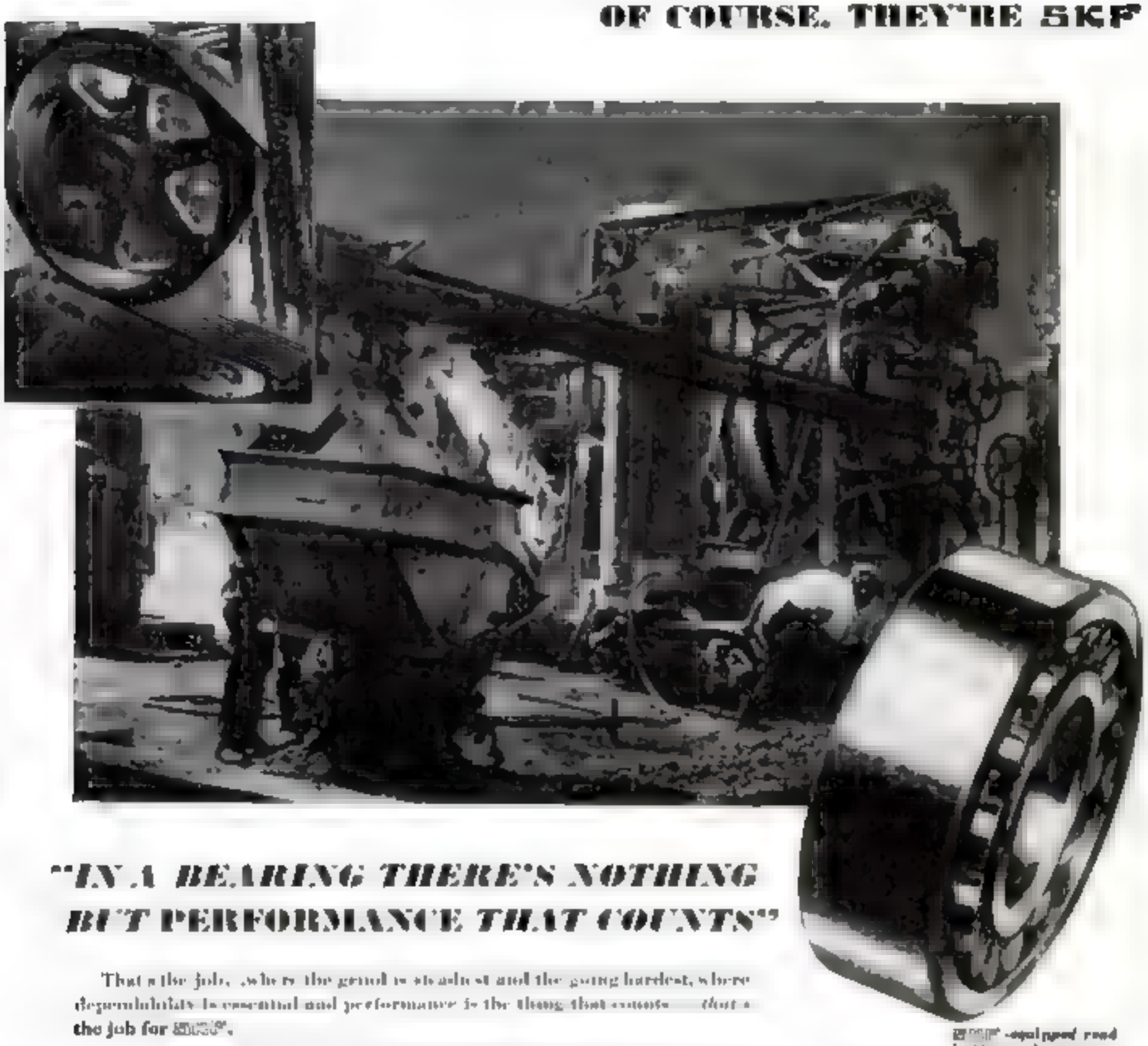


A STRAIGHTENING ANVIL

STRAIGHTENING long pieces of small pipe and rod stock is quite a job when regular shop equipment is not available. An old tire rim, however, can be used for this purpose. Rolling the stock back and forth affords a ready means of testing for bends.—FRANK W. BENTLEY, JR.

ON THE TOUGH JOBS

OF COURSE, THEY'RE SKF



SKF-equipped road building machine (above) and stone crusher (left) using SKF Bearings.

"IN A BEARING THERE'S NOTHING BUT PERFORMANCE THAT COUNTS"

That's the job, where the grind is steadiest and the going hardest, where dependability is essential and performance is the thing that counts . . . that's the job for SKF.

It's no mere chance that you find SKF Anti-Friction Bearings in the railway journals of most of the railroads of the world . . . in most of the great clanging mechanical monsters that build our roadways . . . in practically all of the giant dredges that burrow into river bottoms. Not chance at all. Ordinary bearings would fall down.

The answer is that SKF builds a bearing *up* to a job and never *down* to a price. And whether it's a dime-sized SKF Bearing, functioning in some delicate scientific instrument at terrific speed, or a big brute SKF, taking the punishment of some giant stone crushing machine and *liking* it, depend upon it . . . it was built for the job. SKF puts the right bearing in the right place . . . and in a bearing there's nothing but performance that counts.

SKF INDUSTRIES, INC., 40 EAST 34th STREET, NEW YORK, N. Y.

SKF

BALL AND ROLLER BEARINGS

2741

THE TEMLOK-INSULATED HOUSE IS

now ready

Armstrong Offers a New Low-Cost Building Insulation That Saves Fuel... Insures Comfort

When you plan your new home (or decide to remodel), let Armstrong's Temlok help to give you comfort that is lifelong. The expense is small. You add on an average not more than 1% to your total building costs.

HERE is good news for every home builder and owner—a fibreboard building insulation, gratifyingly low in cost, and with improved physical properties which mean greater fuel saving and permanent home comfort.

This new insulation is offered by Armstrong, famous for fine linoleum and long known as the leading manufacturer of high quality corkboard insulation. Named Armstrong's Temlok, this new product is presented after five years of research and study of the problem of efficient home insulation. It is a golden tan board of pleasing texture, one full inch or full half-inch in thickness, fabricated from the heartwood of southern yellow pine.

Armstrong's Temlok is a definite improvement in fibreboard insulation. Why? First, because Temlok locks **temperatures where they belong. Effectively retarding the passage of heat, this new insulation materially reduces fuel bills and insures greater comfort**

"A PROFITABLE $150 INVESTMENT!"

On the average, $150 is the added cost of insulating a $15,000 house with Temlok. That is a very small sum to pay when you consider the lower fuel bills and the increased home comfort you'll get. Right from the start, your $150 Temlok investment will be paying you cash dividends in the form of lower fuel bills. In fact, the fuel saved in four years will more than pay for all the Temlok used. If you are buying a house that costs more or less than $15,000, 1% of that cost will approximate the slight expense of Temlok.

inside the home—protection against the icy temperatures of winter and the burning heat of the summer sun.

Second, Temlok has a high resistance to moisture and so does not lose its insulating efficiency. The unseen moisture always present in the air is a deadly enemy of insulation. Because moisture conducts heat rapidly, any insulating material which absorbs moisture quickly becomes "short-circuited" and loses much of its efficiency as a nonconductor.

For many decades Nature has been storing up resin in the pine wood from which Temlok is made. The fibres of the pine are so supercharged with this natural resin that they have become highly moisture-resistant. This inherent property of the raw material gives Temlok its unusually low moisture absorption, making it permanently efficient.

Your architect or builder will also tell you that Armstrong's Temlok is structurally strong, yet light in weight. These advantages are important since they help to give your house better construction without adding any further burden to either walls or roof. Temlok is also sterile and without odor. It is easy to handle and install.

Before you decide on insulation for your new home or for any remodeling work, learn the whole story of Armstrong's Temlok. It may be used as a plaster base, or to replace sheathing, or as wallboard for finishing attics, basements, garages, and farm buildings. Your local lumber dealer can supply it at low cost in the form of insulating lath or insulating board.

Mail the convenient coupon below. It will bring you a sample and a booklet telling how you can save fuel and make your home permanently comfortable with Armstrong's Temlok. Armstrong Cork & Insulation Company, 967 Concord Street, Lancaster, Pa.

Armstrong's A Product

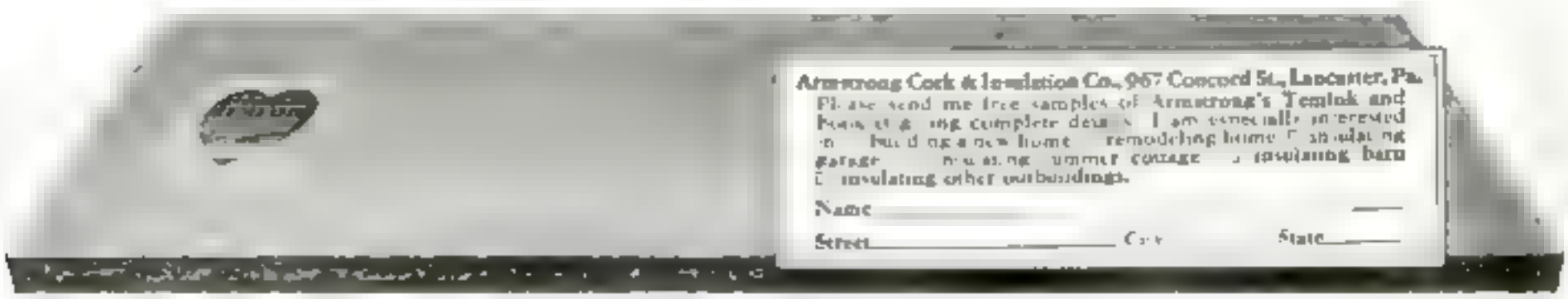
Temlok is strong, but light and quick to handle. It saves and mails easily.

Temlok is the ideal plaster base. Plaster bonds tenaciously to its surface. And no lath marks show through.

Use Temlok in place of lumber sheathing. Does all any sheathing can do—and it insulates.

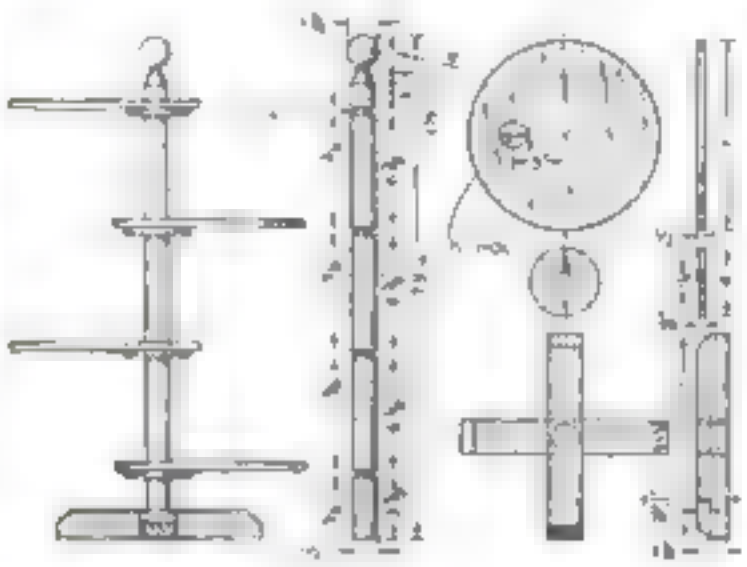
Armstrong's TEMLOK BUILDING INSULATION

MADE BY THE MAKERS OF ARMSTRONG'S LINOLEUM AND ARMSTRONG'S CORKBOARD INSULATION



Modern Stand Has Plywood Disks for Shelves

Used as an occasional table, this modern looking style stand will hold a smoker's set, a book or magazines, a candy box or dish, and bric-a-brac.

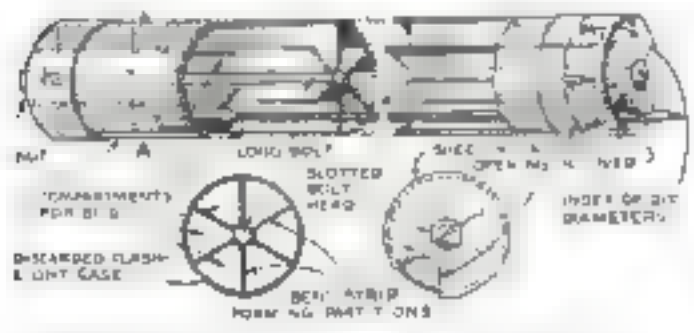


This disk stand or occasional table is practical, decorative, and distinctly modern. The original, which was made from white pine with disks cut from fir plywood, was finished with black enamel and trimmed with silver paint, but any wood or finish may be used. In preparing the four small disks, clamp them together in a vise and bore a 1⅛-in. hole through the center of all with an expansion bit. Then saw them through the center, making the cut with the grain of the face veneer. The center upright is turned from stock 1¾ in. square, the grooves being cut ¼ in. deep with a parting tool. In assembling, begin with the top shelf. First apply glue to the inside edges of one of the small disks and fit the halves together in the groove; then use brads or screws through the small disk to hold the shelf securely. Note that the second shelf is on the opposite side of the center piece from the top shelf, and the third shelf is directly below the first, while the fourth is under the second. The last step is to glue the upright piece into the cross-lap base. A little planing may be necessary to make the base rest evenly.

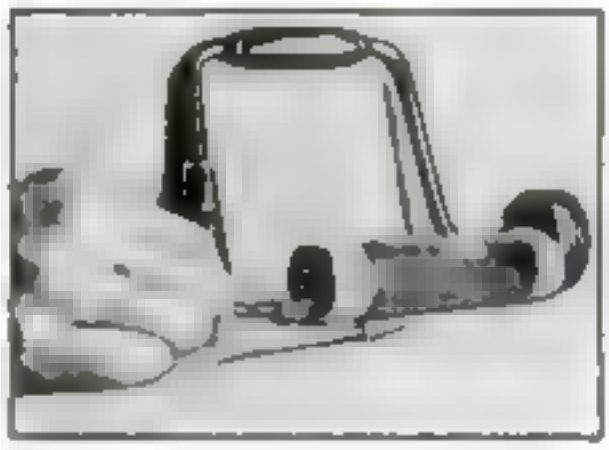
To make the disk table without a lathe, use a wood curtain pole 1⅛ in. in diameter for the upright and fit a knob at the upper end. Instead of the small disks, use short pieces of ⅜-in. wooden dowel rod to support each of the large disks. Drill two ⅜-in. holes at right angles to each other through the upright piece just below each shelf and glue the lengths of dowel in place.—Clyde Tooke.

BIT CASE MADE FROM OLD FLASHLIGHT

A convenient self-indexing holder for bit-stock twist drills and gimlet bits can be made from a large discarded flashlight case. The cover is merely a sheet metal disk with an opening for the bits to slip through, and a central hole which allows it to be mounted on a long bolt passing through the center of the case. This cover may be placed inside the lens cap as shown in the photograph or it may be mounted on the outside of the end, depending upon the design of the holder and personal preference. The six interior divisions are made as shown from three 1-in. strips of brass shim stock as long as the flashlight case. These strips are bent V-shape and soldered to the long center bolt, which is then fastened through the bottom or removable end of the flashlight case. The compartments are labeled on the outside of the flashlight lens cap with the size of the bit each contains. To remove a bit the sheet metal cover is revolved in either direction to a position opposite the size of bit wanted and inverted, whereupon the proper size bit will drop out. A holder for ordinary twist drills can be made in the same way either by using a smaller flashlight case or providing a larger number of divisions.—Ray J. Marran.



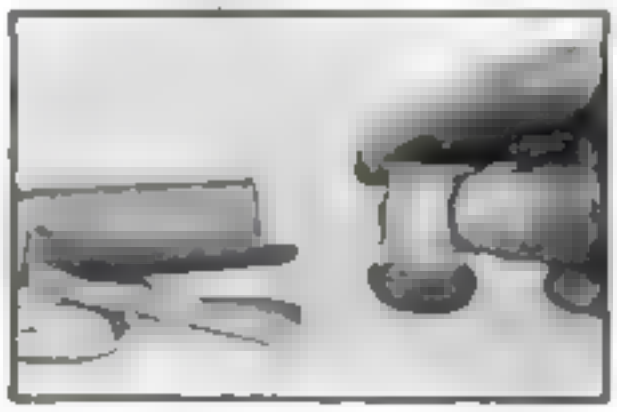
The interior is divided into compartments, and the top revolves so the bits can be removed.



The case from a discarded flashlight may be converted easily into an indexing bit holder

WORN-OUT TIRE CASINGS PAD SHOP SAWHORSES

Discarded tire casings make excellent pads for sawhorses, being firm yet resilient. They wear indefinitely, and since they do not stick to a thoroughly dry varnished surface, they are especially useful for furniture repair work. One casing will pad two 3 ft. long horses. Use an ordinary fine-toothed wood saw to cut the rubber and canvas shoe, and a strong-bladed hack saw to cut through the metal inserted in the lips. Next at intervals of 7 or 8 in., cut through the metal lips and into the sides of the casing for about 3 in. Grasping the cut casing at the center, press it out straight along the top of the sawhorse, the slit sides projecting downward on each side of the cross member of the horse; then fasten the casing in place with a few nails driven through the tabs into the sides of the cross member and the ends of the legs.—J. V. H.



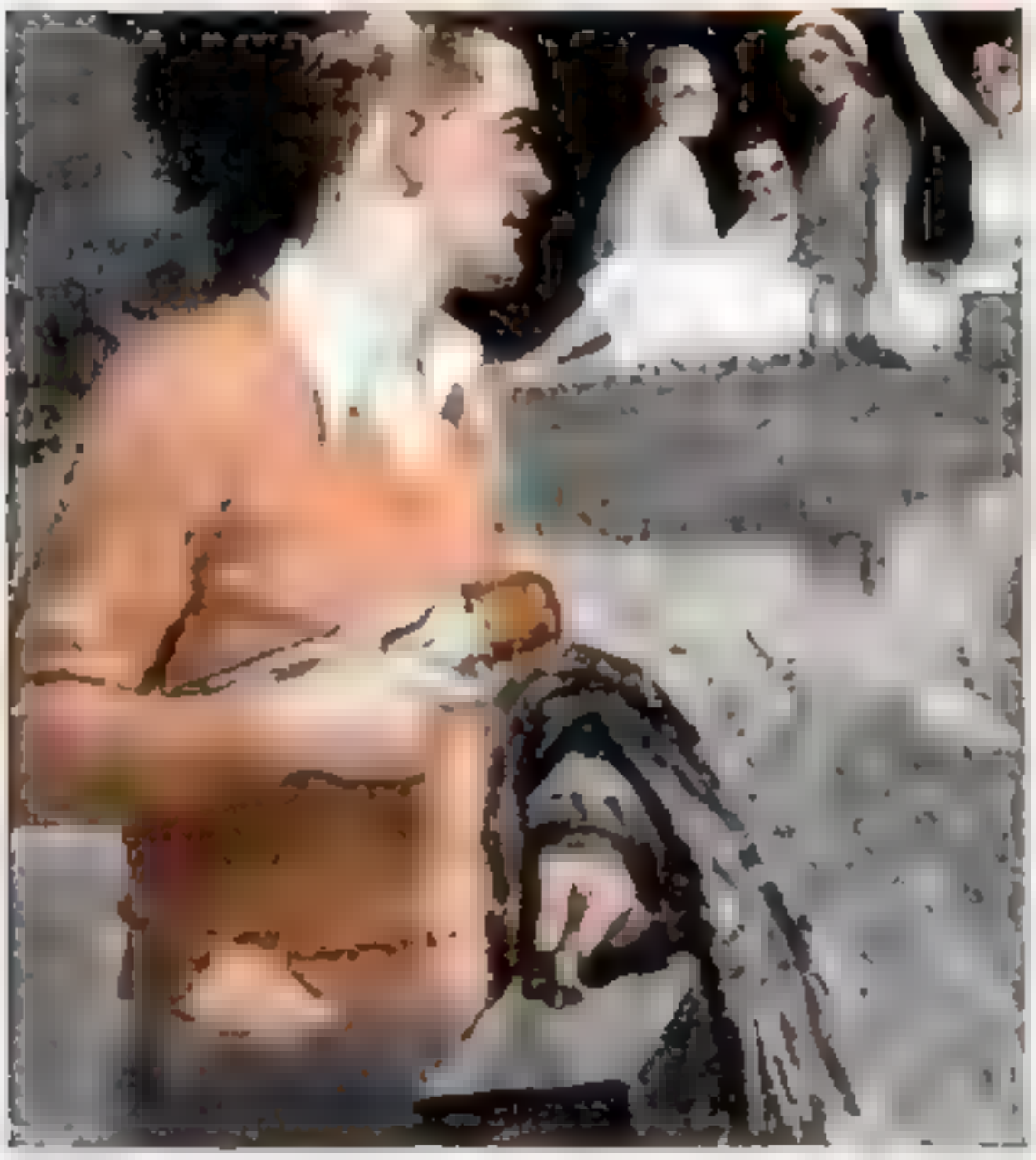
SPOOL USED AS HANDLE OF MOISTENING SWAB

For many jobs about the home which involve patching or decorative work, a moistening swab is often needed to dampen prepared adhesive paper, passe partout binding and other gummed surfaces. Usually a small rag is tied to the end of a stick, but this is hard to get padded just right, and the pad is continually slipping off. A much better way is to lay a small pad of cotton or cloth over the end of an old spool and tie it on with another piece of cloth, as shown. This cannot slip off no matter how roughly used. Water dropped at intervals through the hole in the center of the spool keeps the pad continually moist.—F. W. B.

MITERING MODEL PARTS

Tiny miter boxes for use in model making and similar delicate work may be obtained for nothing by making use of the grooved edge of scrap pieces of tongue and groove lumber. In addition to providing for miter cuts, such a "box" is useful for cutting small parts to accurate lengths. Simply insert a stop in the groove at the desired point.—F. G. Semple.

A Big Day Ahead *with a* Face *that's* Fit



Bright as the morning . . . clear-complexioned . . . eager . . . all's right with his world, and he's ready for a big day.

Any man, anywhere, is always ready for a big day with a Face that's Fit. That's why men who are doing things and going places, start their days with Williams Shaving Service. It's the good-morning way to good grooming.

Try it—see how pleasant, how comfortable your face feels at the first touch of that luxurious Williams lather. So cool So mild So moist. Your skin softens, relaxes. Your razor seems to have a keener edge as it skims through the rich, thick lather, leaving a path smooth and clean. Williams lubricates and conditions. But it never clogs or stings. For there is no grease, no dye in Williams Shaving Cream!

Now for Aqua Velva. Dash it on your moist face. Feel it tingle as it wakes up sleepy tissues. It tightens up the pores, helps to care for tiny, unseen nicks and cuts. It keeps the natural complexion moisture in your skin—keeps your face in the pink of condition.

Millions of face-fit men in many nations start every day right with Williams Shaving Service. No wonder!

JUST NOTICE THE FINE SKINS OF MEN WHO USE

Williams

SHAVING CREAM—AQUA VELVA

MAIL THIS! It will show you the way to Face Fitness

The J. B. Williams Company, Dept. PS-120 Glastonbury, Conn., U. S. A.
Canadian Address: 3552 St. Patrick St., Montreal

I am anxious to try Williams Shaving Service. Please send me trial sizes of Williams Shaving Cream and Aqua Velva

Useful IDEAS for Car Drivers

Mixture Cleans Carbon Out of Motor

WHILE undoubtedly the best method of removing the carbon from an automobile motor is to take off the cylinder head and scrape and polish it away various solvents will have a beneficial effect in many cases One of these mixtures consists of 16 ounces of kerosene, 2 ounces of glycerine and 2 ounces of hydrogen peroxide. The method of injecting this and other mixtures designed to remove carbon is shown in Fig 1. A rubber tube is slipped over the spout of a small funnel and the end of the tube is inserted in the air intake opening of the carburetor. After the motor has been operated until it

Fig 1 How to put carbon removing mixture in car

reaches normal temperature it is set to operate at fairly high speed and then the mixture is slowly poured into the funnel The rate at which the mixture is fed in should not cause the motor to miss

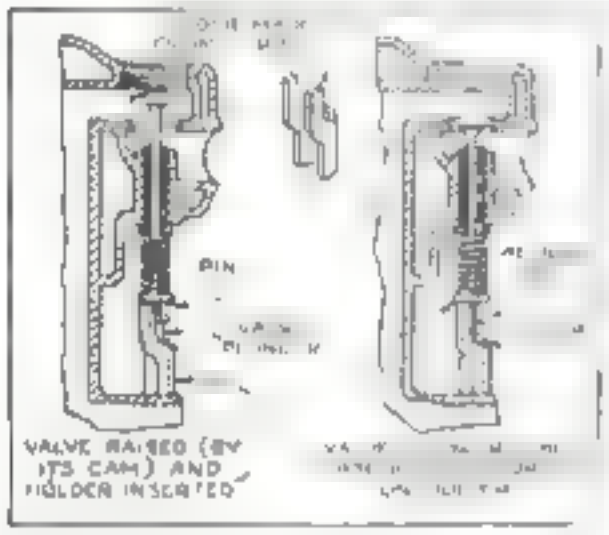


Fig 2 A piece of iron pipe cut out on two sides is handy tool to hold up valve spring

FIG. 2 shows a novel tool designed to facilitate quick valve grinding jobs Instead of using a regular type of valve tool to lift the valve and thus permit the removal of the retaining pin and the spring, this tool is slipped in under the valve as shown while the latter is in the fully open position Cranking the car one full turn will drop the valve plunger leaving the spring supported in the up position by the device. The pin can be removed and the valve ground without disturbing the spring washer and so on.

To make this device take a piece of iron pipe just long enough to slip under the washer when the valve is in the open position. With a hacksaw cut through the side of the pipe in a lengthwise direction. Then cut away enough of the lower portion to permit it to slip over the plunger bushing, opening up the cut in the pipe somewhat so that this will be accomplished without taking away a full half of the pipe. Next cut away the top portion in the same way but removing part of both sides as shown. Be sure the back edge of the top portion is not cut away as far as the lower portion

Fig 3 Silk cloth used over headlight mirror

GLARE from the headlights of cars approaching from the rear often shines in the rear vision mirror in a most annoying manner Fig. 3 shows how to prevent this and still retain the use of the mirror Make a simple frame of heavy iron wire slightly larger than the size of the mirror Hinge this at the bottom under the top portion of the mirror mounting as shown. The details of the method depend on the method of construction. Cover the frame with a single layer of thin black silk cloth. If the cloth is thin enough, the headlights of cars behind will show through sufficiently

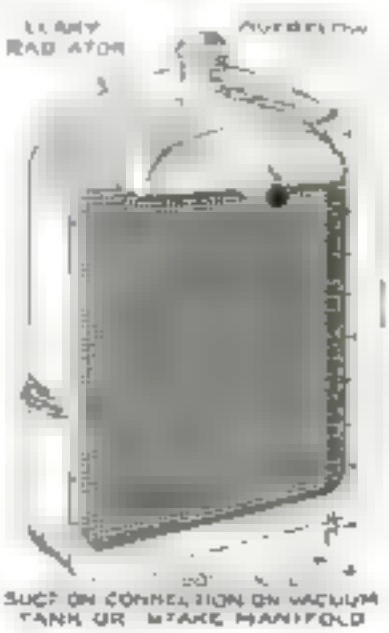


Fig. 4. How air pressure is used to stop leaky radiator

MANY methods have been proposed for emergency radiator repairs A most ingenious one is shown in Fig. 4. Instead of attempting to repair the leak atmospheric pressure is utilized to keep the water from coming out. If you find yourself a long way from a service station and the radiator develops a leak, remove the rubber tubing that is used to operate the windshield wiper at the wiper, and slip this end over the end of the overflow pipe instead. If the radiator cap fits reasonably air tight, the reduced pressure created in the radiator will cause air to flow slowly through the leak into the radiator and while that is going on no water can get out So long as the motor is running the radiator consequently will not leak a drop Of course this method will not work with a severe break in the radiator such as an open seam in the upper or lower water compartments as the large opening would let through so much air that the carburetor mixture would be disturbed and the motor would miss.

THE air pressure in tires should be regulated by the load in the car and not by sticking to some arbitrary figure For example, if you are going on a long drive alone the car will ride better and the tires will not suffer if the pressure is dropped from three to five pounds in the rear shoes. The front shoes also could be operated at lower pressure with improved riding qualities but soft front tires often result in shimmy

DOUBLE filament headlight bulbs are no longer useful in the headlights when one filament burns out However these bulbs can be converted into single contact bulbs useful for dome, stop lights and so on by a simple job of soldering. If you examine such a bulb you will find that there are two contacts at opposite sides of the insulation that protrudes from the base. Take a soldering iron as shown in Fig. 5, and flow a little solder across the insulation joining the two contacts. Be careful that no solder flows down over the insulation and makes contact with the metal shell as this would cause a short circuit

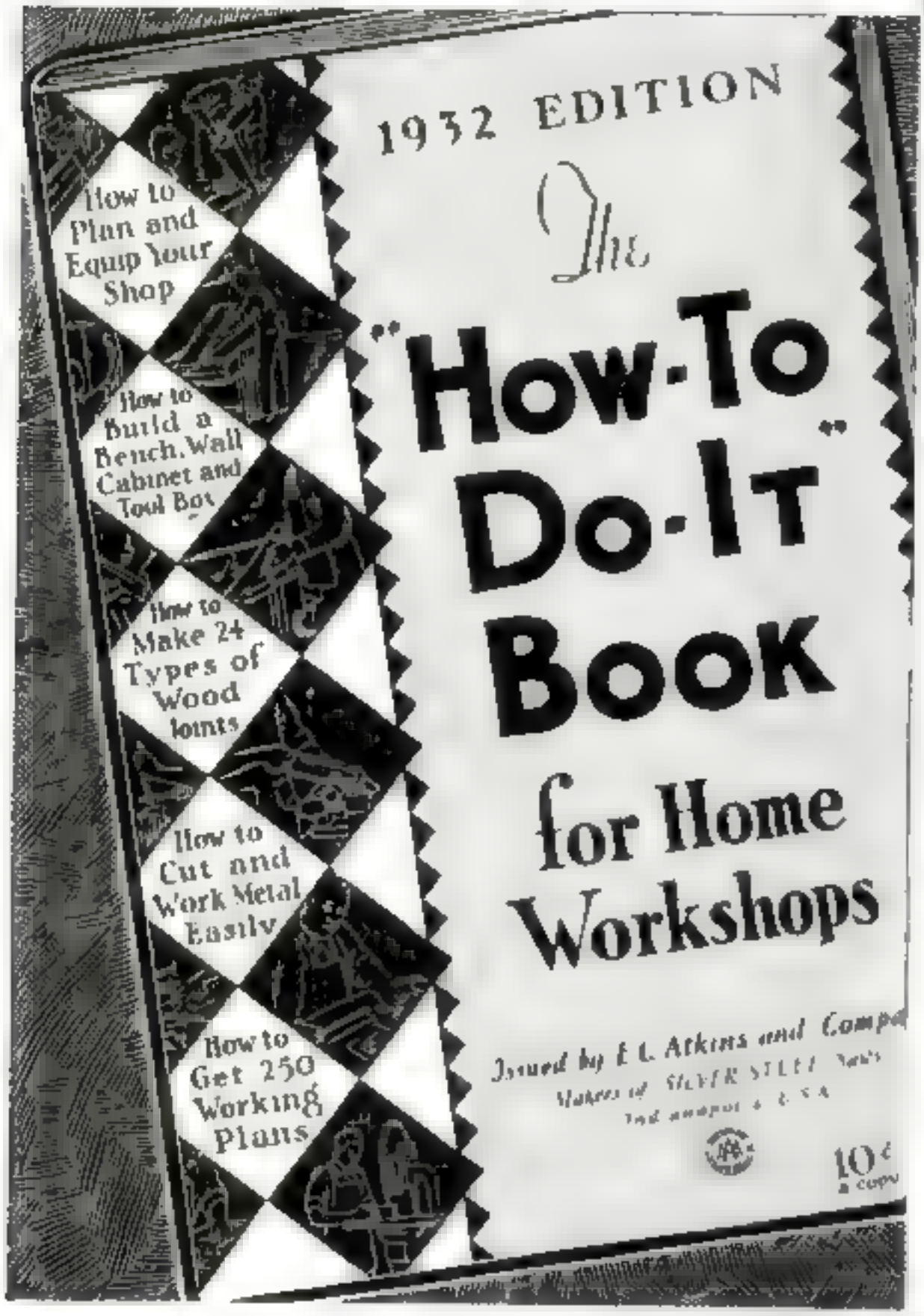
Fig 5 Solder turns double filament bulb into a fine stop light

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to R. H. Moore, Lombard, Ill. (Fig. 4). Contributions are requested from all automobile mechanics and if published will be paid for at regular space rates.

This NEW BOOK

Shows You HOW to Do Things ...Easier, Quicker and Better



...How to Plan, Equip and Enjoy a Home Workshop

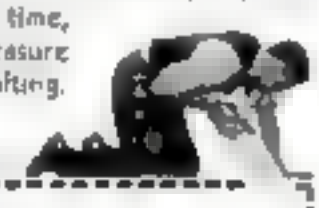
HERE is the ATKINS *second* book for home craftsmen! So successful was the first book that FOUR large printings were needed to satisfy the world-wide demand! Now, we announce an even larger and better handbook—brimful of latest information on workshops—at the same low price.

Whether you are a beginner or an "old timer" in home-crafting, you'll find a host of helpful ideas in this new book. If you want to start a new shop, it tells how to plan and equip one. Or, to modernize your present shop, it shows the ideal arrangement. If you want to make better joints, it shows how to cut and fit 24 types. If you wish to build a new work-bench, or other shop furniture, it gives diagrams and full directions.

If you do decorative metal work, it shows easier ways to cut and shape the pieces. If you want new project suggestions, the revised "What to Make" list is a gold mine of ideas. And, if you plan to add new tools, it shows you 50 of the world's finest saws for home shops, and explains why "Silver Steel" saws always give the best service and value that money can buy.

This new book costs only a dime, but you'll say it's worth a dollar when you see what an immense amount of practical instruction is condensed into the 36 pages. Written by veteran craftsmen, every page tells you how to do some feature of shop work quicker and better.

Send for your book today. It will help improve your skill, save your time, and double your pleasure or profit in home-crafting.



Read This List of Features:

Much helpful material from the first book has been revised and restyled, and several new chapters added. The 1932 edition contains

Home-crafting—a Hobby that Pays, in Pleasure and Profit.

How to Lay Out a New Shop. Showing three typical floor plans for arranging the shop furniture, tools and machines.

How to Select Shop Tools. Money-saving hints on choosing saws, tools and machines for small, medium or large shops.

How to Choose Woods for Shop Work. Also data on veneers, plywoods and compositions.

How to Cut and Fit Wood Joints. Instructions for making 24 types from simple butt joints to complicated dovetails.

How to Equip a New Shop. Building a bench, folding work table, saw horse, tool box and seat, wall cabinet, miter box, etc.

How to Cut Metals in the Home Shop. Newest methods for working metals with hand and power tools. Hack saws, circular saws, band saws, composition wheels, etc.

How to Use Grinding Wheels and Files.

What to Build, and Where to Get Job Plans. A unique reference list of 250 things to make of wood or metal.

50 Popular Saws and Tools for Shops.

Cut Out This Coupon

E. C. ATKINS and Company, Est. 1857
428 S. Illinois St., Indianapolis, Ind.

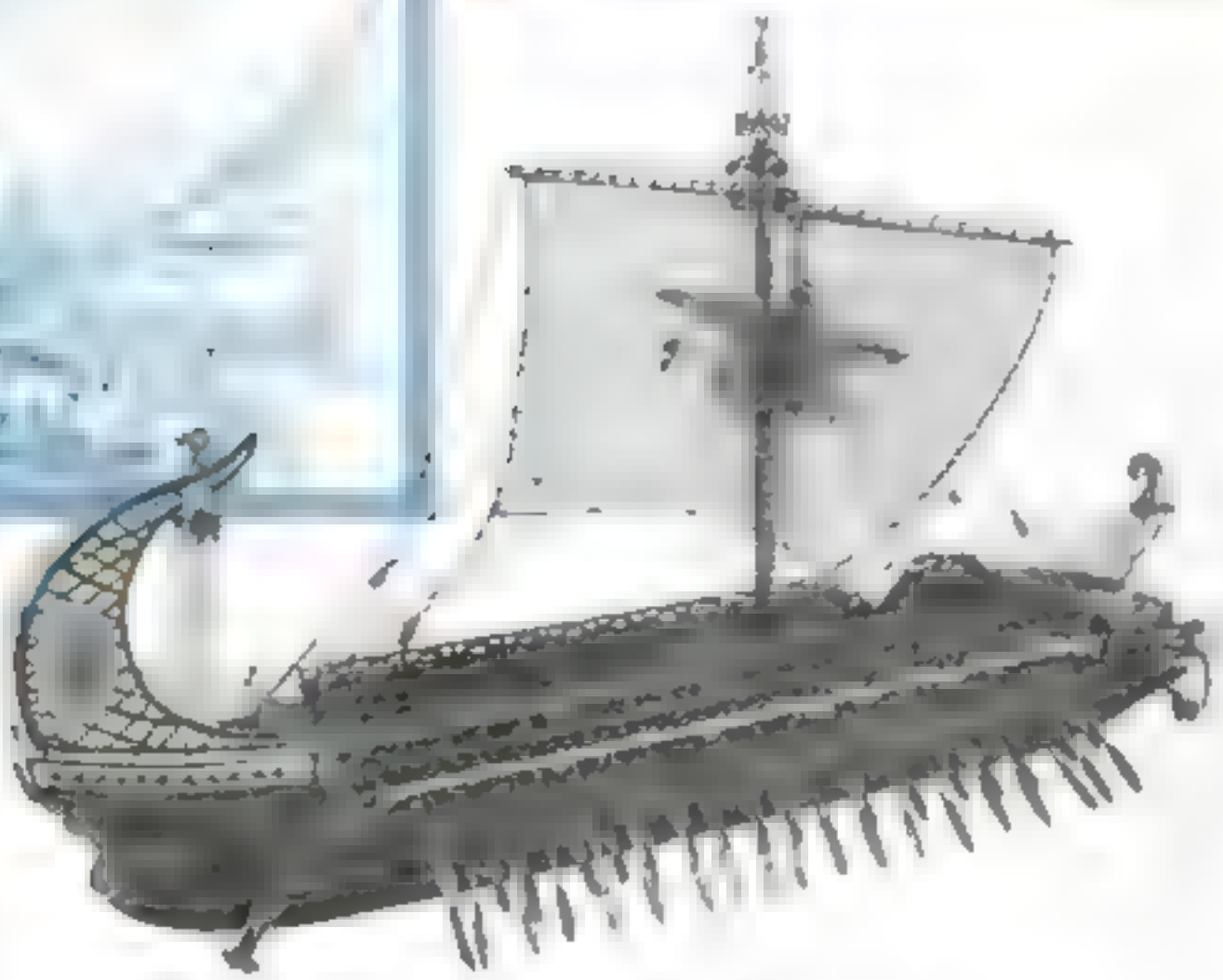
I enclose a dime for a copy of the ATKINS 1932 Home [redacted]

Name [redacted] Print

Street [redacted]

City [redacted] **State** [redacted]

My dealer is [redacted]



By Capt. [illegible] McCann

Our *Roman Galley Model*

TAKES on LIFE and COLOR

THOSE who have already built the hull of the decorative Roman galley model described in our last issue (P S M., Sept. '31 p. 78) are now ready to proceed with the superstructures and details. Those who did not get that issue but wish to make the model can do so by sending 50 cents for Popular Science Monthly Blueprints Nos. 138 and 139 (see page 112), which give all details full size. The fact is, you should have these blueprints in any case because they make the work so much easier

At each end of our galley are typical shelters made of five-ply Bristol board such as is used by artists. These shelters apparently varied much in shape so you may modify the design if you wish

The forward erection consists of two pieces as in detail *G*, with flaps which are turned under and glued to the deck near its edge. The two front edges are joined with strips of glued paper, inside and outside. Some glass-headed belt pins are useful for holding the flaps to the deck until the glue dries. On top of this is glued a small square of wood with molded edges A little plastic material will help to retain this. Above is a curl made by fret-sawing a piece of wood to the profile given and trimming it with knife and file

An ornamental treatment is suggested for the sides of this structure. It may be carved, laid on with gesso, or merely painted, but an easy and effective way is to cut out thin cardboard parts and glue them on, and do the same for the moldings around the edges. I decorated the figures and the curl in gold and the background in silver, and painted the molding a rich blue. The stem is scarlet, and the same color is carried over the square piece and extended in decorative points to the tip of the curl. The inside is white, very slightly antiqued.

At the stern there is an inner hoodlike shelter, also made of Bristol board to the shape given in detail *H* There are two sidepieces which are glued to the deck, the flaps being bent outward, and one backpiece H^1 that fits between them and is fixed with glued strips of paper

The columns should be erected before this part is fastened down. Two oblong blocks are fitted against the pieces *H* and glued to the deck to support the columns. The tops of the columns have curves filed in them to take a crosspiece 5/16 in. in diameter and $1^3/_4$ in. long. This crosspiece has two saw cuts in the top into which pieces *H* are fitted and glued. If you can find two fancy upholstery nails to ornament the ends, it will save the trouble of carving them

Having set up the columns, glue down the two sidepieces *H* to the line given on the deck plan. It might be well first to cut patterns from stiff paper to see that they will drop into the slots in the crossbeam. When you have them fastened, glue the backpiece in position as shown

Sidepieces *H*, like the forward ones *G*, should have suitably shaped strips of cardboard glued along their edges for moldings; the forward edges of these can be put on before erecting the shelters, but the after moldings should go over the binding strips. They also can be painted before being attached. I decorated the stern shelter with basketwork stripes in red on white and shaded the edge of each stripe, then I glued a medallion of Apollo on one side and Athena on the other as shown in detail *K* The figures are gold touched up with dark brown on a blue background. Squarely above the crossbeam, cut a slot in H^1 and in it glue two gilded pieces as shown, Separate them ¼ in. at the top.

ALONG the outer edge of the afterdeck there is a low railing, it is cut as shown in detail *M* and has its flaps turned in and glued to the deck. It is ornamented with a red design on a silver ground. and there is a gold ball in the middle. The molding is blue and the inside parts are white. The gilding throughout can be done with liquid gold paint, but if you can lay gold leaf, which is not difficult, it is more effective and lasting

At the corners of both the fore- and afterhoods, I bored holes in the deck and erected ⅛ in. square posts, these were

then glued to the cardboard sidepieces.

Beams are nailed across the hull at both ends (see detail *N* on Blueprint No. 138) They are square pieces of wood with lion s heads carved on the ends, from the mouths of which rings hang down. Both may have notches cut in them for the stays. The afterbeam also requires slanting notches in the forward corner, close to the edge of the deck, for the steering oars to work in. The anchors will be hung on the forward one. The ends of both should be gilded or coppered

PROJECTING from the bow are four large spears to stick in o an opposing vessel. These are stained brown with silver points and should be stapled to the hull with copper wire.

Across the front end there can be molded or painted a wreath with crossed torches as shown, flanked by a pair of pyramida,-headed upholstery nails. Holes for anchor and cables should be bored in the sides of the bow and framed with shoe eyelets

The anchors can be of the usual shape, but quite stubby, and with short arms or stocks, or they may be of the grapnel type shown on the assembly drawings. They can be made easily by hammering copper nails to shape. Do not smooth them too much, and give them a coat of orange or brown shellac, if made in this way, to preserve the copper color. The cables lead from their rings, under the spears, to the hawsepipes.

Now for the oars; for the *biremc*, 38 long ones and 36 short ones are needed. If you go to the drug store, you can get a handful of doctor's swab sticks (applicators) for a few cents. Sandpaper them very lightly and cut to length (3 ½ and 2½ in.); then for ½ in. at one end of each cut a slight flat, and point the back. Cut the required number of blades from Bristol board as in detail *P* and glue these to the flats cut in the oars. Then stain the shafts light brown and dip the blades in a pot of red paint. If your hull is solid, make the oars only long enough to project the necessary distance

Put them in their holes with a touch of glue so that the ends of the upper and lower blades are in straight lines, with the blades either horizontal or sloped to face very slightly aft (at the feather). If you have made holes larger than the oars, it will be necessary to stretch lines (swifters) from staples in the hull and tie the inner ends to these so that the oars will be kept in position

The steering oars are made from pieces of ⅛ in. round wood, slit at the ends to take the cardboard blades, which are painted red with gilt edges. Through their upper ends they should have crossbars They are lashed to the crossbeam

THE MAST, which is 8¼ in. long from the deck and stands upright, is a piece of ⅜ in. dowel stick, tapered a little toward the top and with two grooves cut at the top. The yard is made of two small pieces of dowel, each 6 in. long, overlapped and lashed together in the middle. The sail is cut to the shape shown. Instead of hemming the canvas, I overstitched it with a cross-stitch in colored silk twist and lashed it to the yard with the same silk The sail may have any one of many designs painted on it. On my own model I used the winged horse Pegasus. This I laid on with gold leaf and shaded with Vandyke brown.

Lashed close up to the masthead are two large blocks, and two smaller ones not so close. Through the former lead halyards from the middle of the yard to bollards (see the deck plan) set in the deck abaft the mast, from the other two, lifts from the yardarms are carried to the same bollards. The lifts are made fast to the yard and from there lead aft, serving as braces. Take them to the cuts in the after crossbeam, but to opposite sides. I braced the yard around a bit so that one can see the sail better. From the lower corners of the sail the sheets are stretched loosely aft and fastened to the railing.

FROM the masthead also come bights of cord with two ends leading forward and two aft These terminate in blocks having lines which are hauled tight to the holes under the crossbeams

To the top of the mast should be glued a small top for archers. This I made of cardboard as in detail *Q* and painted it to give a red basketwork effect

The correct thing to have above this is a staff with a cross-board on which are painted the letters S. P Q. R., above which should be a laurel wreath and then an eagle. The cross-board and wreath may be made from strips and rings of cardboard glued together and with slots cut in them for the brass rod, another piece then being glued on the back. The eagle I obtained from a maker of club insignia, but it can be made from cardboard or gesso, or carved from boxwood, as, indeed, can the whole design. All this I gilded.

This completes our unit of the mighty Caesar's fleet

Another noteworthy ship model article by Captain McCann will be published in the November issue

Detail drawings of the bow shelter, the stern hood, the ornamental rails, the mast and sail, the oars, and other parts, all of which appear full size on Blueprint No. 139; and a perspective drawing of the assembled model.

How to Build a Hunting Lodge

COMFORTABLE · STRONG · DURABLE

WITH

INSULITE

the Wood Fiber Insulating Board

DO you ever long for a cozy cabin all your own near your favorite hunting grounds, or by that lake where the fish bite best? Why not build one—it's easy. With The Insulite Co. Blue Prints, any man handy with a hammer and saw can quickly erect a strong and durable cabin that will be comfortable in any weather.

Of course, your cabin should be built with Insulite. This full ½ inch thick, all wood-fiber insulating board shuts out heat in summer and cold in winter, insuring year round comfort in any kind of weather.

Made from the tough fibers of northern woods, chemically treated to resist moisture, Insulite is not subject to rot or disintegration. Insulite left exposed to the weather for over 15 years shows no appreciable loss of insulating value or tensile strength.

Because of the structural strength of Insulite and its light weight, if you desire, your cabin may be built in sections at home and easily transported to the site you own or rent and quickly set up. Rear Admiral Byrd used Insulite and took his cabins in sections to the far polar regions.

Now is the time to build your Hunting Lodge. Send for the Insulite Blue Prints. They're complete in every detail—easy to read—and they will be sent to you free on request. Just send us your name and address. A few hours' work now will bring you many days of pleasure through the years to come. Write today.

THE INSULITE CO.
1200 Builders Exchange, Dept. 43J
Minneapolis, Minnesota

OFFICES IN ALL PRINCIPAL CITIES

BACHUS-BROWN INDUSTRIES

INSULITE
the Wood-Fiber Insulating Board

FREE GARAGE PLANS

If you are thinking of building a garage, send for a copy of our booklet, "How to Solve Your Garage Problem." It contains complete plans and how to build a one or two car garage

Hints *on* Rough Turning

By W. J. FREDERICK

WHILE solid turning tools are without a doubt the best suited for rough turning operations, I have found that very good results can be obtained with an ordinary tool bit and holder, provided the bit is specially ground for the work.

In Fig. 1 at *A* is shown how a left-handed tool bit should be shaped for rough turning. A larger angle is ground across the top of the tool, as shown in the front view, and the cutting edge is just touched up to the regular angle; this allows greater clearance for chips to curl—a desired result. This is especially advantageous for rough turning high-carbon steel.

As will be seen in the side view, tool *A* is ground straight across instead of in the ordinary way, as shown at *B*. This is because a tool such as *B* becomes shaped as shown at *C* after a few grindings, and then it is absolutely useless for rough turning. In regrinding tool *A*, on the other hand very little has to be removed from the top since most of the wear is on the point; therefore this tool will hold its original shape a longer time and consequently is more economical. In fact, I have done two or three times as much work at one grinding with a tool bit like *A* as with one shaped as at *B*.

Much of the time required to loosen and tighten the tool holder and change its angle can be saved by using tool bits of various shapes as shown in Fig. 2. A straight tool holder set at about 30° to the cross slide (60° to the axis of the lathe) is used throughout. Then, for cutting to distances of more than 1 in., the tool bit is ground as at *A*, the cutting edge being marked with a heavy line. Tool bit *B* can be used for the same purpose and generally for small shoulders and small radii as well as for turning short lengths of the shaft proper. Tool bit *C* is used for straight turning and is better than *B* except for the fact that *B* will cut more closely into a shoulder. While seldom used, tool bit *D* is useful for such work as finishing oil "fingers" as shown.

Radii can be rough turned quickly and neatly on a shaft in the manner illustrated in Fig. 5. If you are using a tool like *A* Fig. 2, turn the shaft down to the size of the small diameter (in this case 5 in.) plus

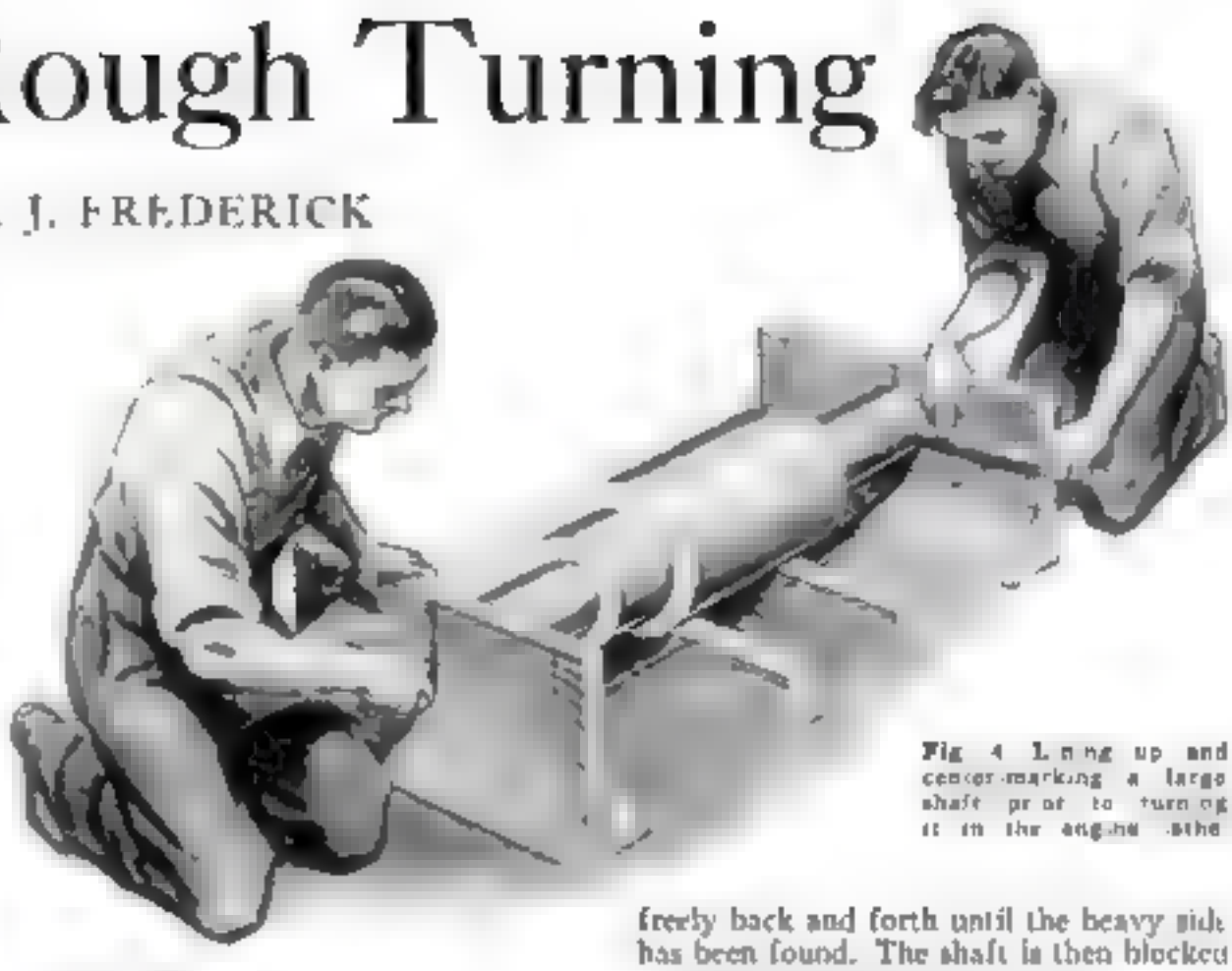


Fig. 4. Lining up and center-marking a large shaft prior to turning it in the engine lathe.

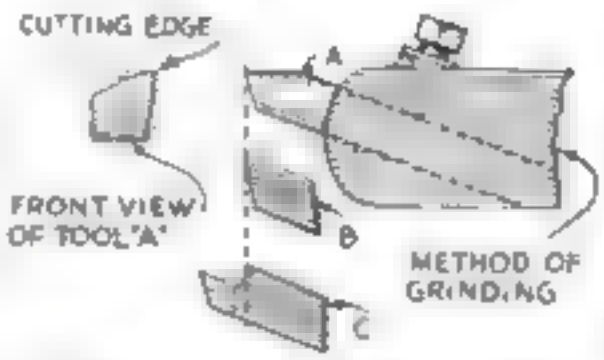


Fig. 1. How a left-handed tool bit should be shaped for rough turning is shown at *A*.

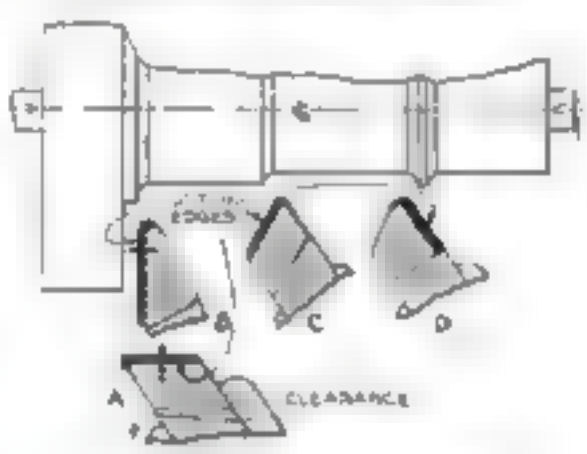


Fig. 2. Much time can be saved by using tool bits shaped for each particular purpose.

twice the size of the radius (1½ in.) or 6.5 in. Then use tool *B*, Fig. 2, to turn the shaft down to the required 5 in., stopping within ½ in. of the shoulder and finish round out the fillet.

Crooked shafts can be lined up before being turned by the method illustrated in Figs. 3 and 4. I have saved several large shafts by this method after work had been started on them and it had been found they could not be cleaned up. Two boards are nailed lightly together and three saw cuts are made as shown, whereupon the boards are separated. All scale is chipped from the shaft to be centered and its ends are chalked. Next the shaft is placed on two 2 by 4's on the floor and rolled freely back and forth until the heavy side has been found. The shaft is then blocked so that the heavy side is down.

Place the boards at each end of the shaft so that they are about central, blocking them up vertically if necessary. Then stretch fishline between the outside pairs of saw cuts. Now line up the shaft accurately by figuring the distance that the string on each side should be from the shaft. For example, supposing there are three finished sizes, 12, 8, and 5 in., as in Fig. 3 subtract these dimensions in each case from the known distance between the cords and divide by two (as 12 in. subtracted from 18 in. equals 6 in. and divided by 2 gives 3 in. the minimum distance there must be between the shaft and the fishline on each side.) When the shaft has been lined up as well as possible draw lines on the ends through the middle saw cut, using a scale or a hack saw blade. Remove the boards, revolve the shaft 45°, and repeat the lining-up operation. Center punch the ends of the shaft where the two lines cross, and drill for centers.

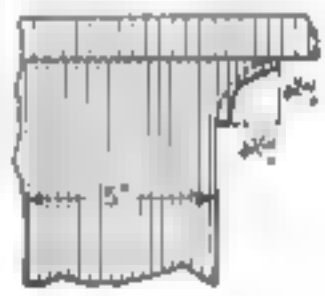


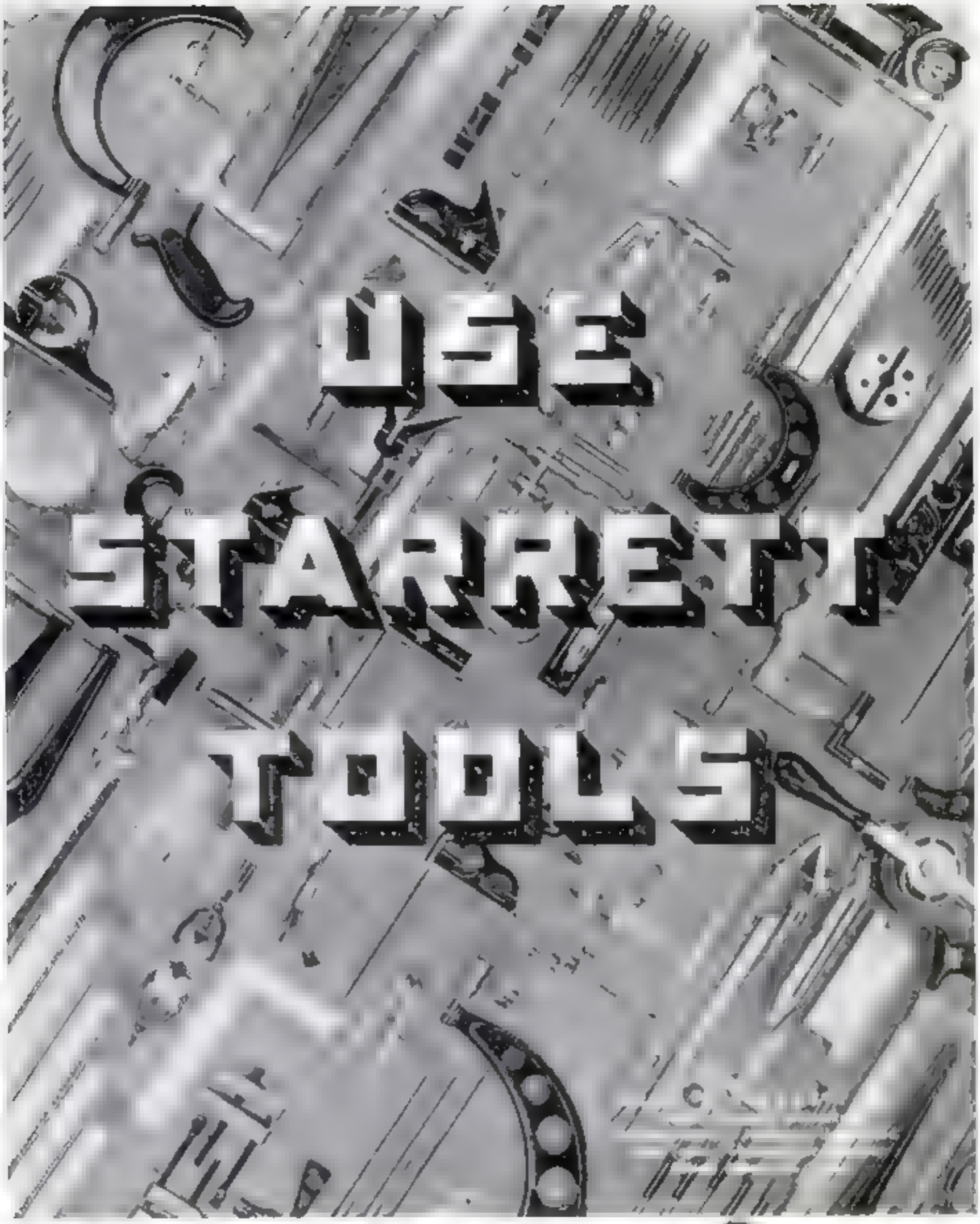
Fig. 5. How large radii can be neatly and quickly turned.

For rough turning, it is well to use solid calipers that work freely, because spring calipers catch too readily.

Fig. 3. Diagrammatic sketch showing how two slotted boards and some fishline can be used to line up a crooked shaft.

SHOP USES FOR SOAP

A BAR of soap is invaluable to the mechanic. A leaky gasoline pipe union or coupling can almost always be cured at least temporarily, by rubbing soap in the threads. Soap can be effectively used in babbitting jobs for holding the asbestos packing in position over places where the hot babbitt would otherwise find means of escape. Soaping wood screws makes their insertion much easier in hardwoods and often prevents the screw from splitting the wood. If mice happen to get into the shop, plug the nest hole with a piece of common laundry soap. L. B. ROBBINS



Write for Starrett Catalog No. 25 "W"

Use Starrett Hacksaws

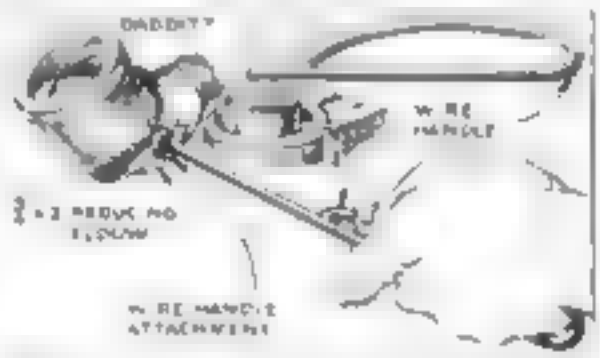
SHOCKPROOF HOOK FOR ANGLE IRON

Supporting long angle stock at the punch press with a hook that has a strong coil-spring shock absorber.

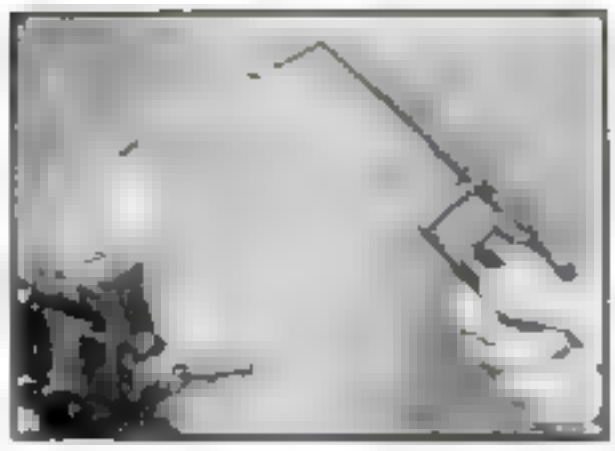
By means of the special shock-absorbing hook support illustrated it is possible to handle long sections of angle stock easily and safely at the punch press and similar machines. The lower part is made by bending a suitable length of rod stock to the shape shown. There is a loop at one end to take the hoist hook, and a narrow V-shaped hook at the other end with a projection upon which the angle iron rests securely. While this projecting support at the lower end of the hook should vary with the size of the stock being handled, it will be found that one size of hook can be made to serve for several sizes of angle iron. Much of the impact received when the punch press completes a stroke can be taken up by adding a spring shock absorber to form a connecting link between the angle hook and the hoist as in the illustration. This consists of a housing and a 1 in. eyebolt 8 in. long around which is placed a heavy 3 in. coil spring. The spring, which bears against the upper end of the housing and against the nut on the eyebolt, is compressed when tension is applied to the lower hook. The U-shaped frame can be forged from steel plate, and a 2 by 4 by 4 in. block bolted in the lower end serves to support the hook (see drawing).—Joseph C. Coyle.

SHOP LADLE MADE FROM STEAM PIPE FITTING

When it is necessary in an emergency to melt Babbitt metal and no ladle is available, an excellent one can be improvised from a reducing pipe ell with a wire handle attached as shown. I have a ¾ by 2 in. steam fitting which saved its weight in gold the day the jobs was born in a remote shop in Naguabo, P. R.; and it has since remained in regular everyday service.—F. W. Hutchinson.

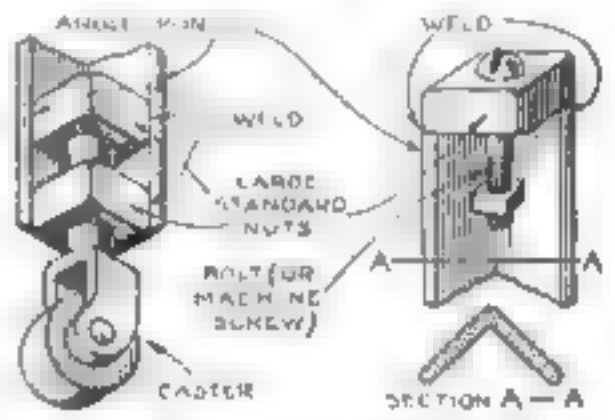


For melting Babbitt metal in an emergency, a reducing elbow makes a serviceable ladle.



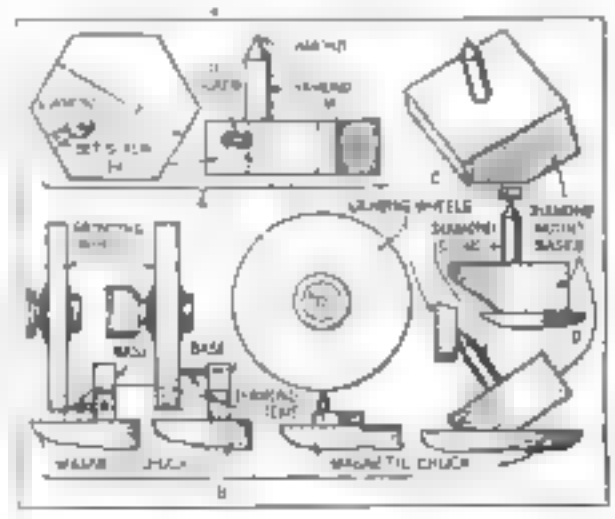
ASSEMBLING BENCH LEGS FROM STOCK PARTS

In making up angle iron legs for benches, tables, and stands, it is often possible to save time and expense by welding nuts at each end as illustrated in the accompanying sketches. One nut at the top provides a convenient means of attaching whatever the leg is to support; and two nuts at the bottom form a socket for the caster. It is not necessary to use brazing wire as both the nut and the angle iron fuse sufficiently to make them like one piece.—Charles B. Bass.



HOLDING A DIAMOND FOR SURFACE GRINDER USE

The task of dressing a grinding wheel on the surface grinder can be expedited and simplified by the use of a hexagonal mounting for the diamond stem or holder as illustrated at *A*. Since the mounting is 1 in. thick and the hexagon 3 in. across the flats, the edges present ample surface to the magnetic chuck, thus making it unnecessary to use angle plates and clamps. This type of mounting also allows the diamond to be set at various heights quickly and without altering the position of the wheel (see examples at *B*). The holder is fastened in the mounting with a headless set screw as shown. A variation of the hexagonal mounting is the square base shown at *C*. In this case, one corner is removed to allow an angular adjustment as at *D*.—F. J. Wilhelm.



Old Bill *Says* . . .

If the grain of a grinding wheel is too fine for a certain job, open it up by passing the diamond across the face faster than usual.

A good follow rest for long threading jobs can be made by grinding the bore of a roller bearing to a sliding fit on the shaft and mounting it in the jaws of the steady rest, which should be bolted to the carriage.

When grinding your lathe centers, do not guess at the angle. Use the gage.

When consulting a chart or handbook on the use of the dividing head, bear in mind that the word "holes" is usually intended to mean the spaces between the holes.

A lap can be charged and also increased slightly in diameter by using two discarded files charged with lapping compound. Hold them with a light pressure against the slowly rotating lap. Used in this way, the files have a slight knurling effect.

"Don't make me study Music . . .

. . I want to be a Mechanic!"

Harry Schams finishing a "go and no-go" gage, used to calibrate diameter of important part for a measuring instrument made by Leeds & Northrup Co. of Phila. Pa.

WHEN Harry Schams was a little boy his folks wanted him to be a musician. But he could only dream of the day when he would be a real mechanic—and the humming of a lathe in the shop was music enough for him. That's where his heart was; that's where he wanted to be. And that's where he is now—an expert, veteran toolmaker at Leeds & Northrup in Philadelphia, where some of the most accurate temperature control instruments in the country are made.

It's 24 years since Harry Schams served his apprenticeship, and he still has some of his first precision tools! "Of course," he said, "I've worn out many a 'mike' but, outside of that, I never replace a tool unless I see one so much better than my old one, that I've just got to have it!"

He had just finished grinding a "go and no-go" gage, used to calibrate the diameter of an important part for an extremely delicate measuring instrument, requiring the very closest accuracy. The gage itself must be true to .0001 of an inch and, as the picture shows, Harry's starting to check it with a Lufkin Telescoping Gage.

Glancing up, he said: "This tool is a good example of what I said before. It has one big and necessary improvement over the old Telescoping Gages, its two plungers both telescope and therefore the handle can always be locked in the center. That gives the tool just the balance and feel every good mechanic wants."

It has this other distinctive feature: it is so constructed that it will readily measure any opening within its capacity. It is made in sizes to enter holes from ½" to 6". Its finish represents the finest work in modern toolmaking. The ends of the plungers are hardened and ground to a radius, giving clearance in the smallest hole the gage will enter. Used with a Micrometer, measurements to .001 of an inch and less can be obtained.

Lufkin Precision Tools carry definite improvements over all other tools of their kind, and the new Lufkin Telescoping Gage is no exception.

Close-up of LUFKIN Telescoping Gage in use on a blanking die.

For accuracy, improved design and construction, finer finish and balance—demand

LUFKIN PRECISION TOOLS

THE LUFKIN RULE CO. SAGINAW, MICH.

106 LAFAYETTE STREET, NEW YORK and WINDSOR, ONTARIO

No. 79A—Range, ½" to ¾"
No. 79B—Range, ¾" to 1¼"
No. 79C—Range, 1¼" to 2⅛"
No. 79D—Range, 2⅛" to 3½"
No. 79E—Range, 3½" to 6"

Also packed in sets of 3 and 5 in red leatherette cases.

Send for this **FREE CATALOG**

11? pages containing valuable tables of decimal equivalents … details of threads … and description of the complete line of Lufkin … Tools … Micrometers, Calipers … Combination … Rules … Screw Pitch and Radius Gages and practically every other fine tool the shop requires.

THE LUFKIN RULE CO. Dept. J SAGINAW, MICH. U. S. A.

Please send me Lufkin Catalog No. 4

Name

Street

City State

LUFKIN MANUFACTURERS FOR OVER 45 YEARS
MEASURING TAPES—RULES—TOOLS

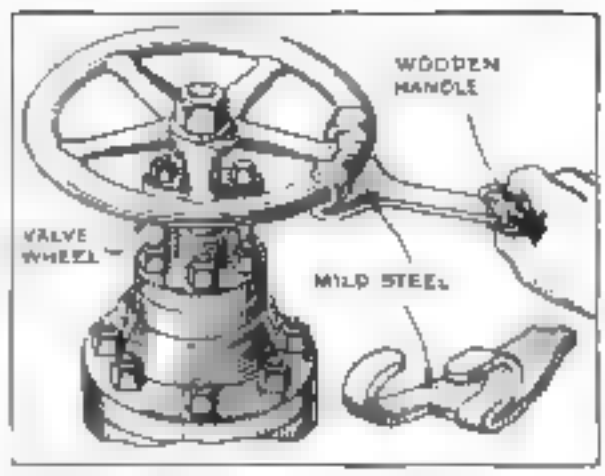
Ⓢ This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS . . . See page 8

USING PRUSSIAN BLUE WITHOUT WASTE

Twisting the top of the grease cup squeezes Prussian blue on the work.

MACHINISTS and garage repair men who use Prussian blue, which is usually purchased for economy in cans rather than tubes, will find that an ordinary pressure grease cup makes a convenient container from which to squeeze the pigment without waste on the work. A small pipe cap screwed on the nipple at the end of the cup, as illustrated, allows the color to be carried in the tool kit with the assurance that it will not become smeared over all the tools. When the blue is to be used, a small amount can be forced out by turning the top of the cup. A similar container is useful for carrying lapping compound.—H. L. KETCHAM.

BOTTOMING taps are less likely to break if the holes are first bottomed with an old drill ground for the purpose and rounded on the end only enough to provide a small fillet at the bottom as a precaution against the cracking of the work when it is heat treated.



LEVER AIDS IN SEATING HANDWHEEL VALVES

BY USING the simple valve wheel lever illustrated, it is an easy matter to open and close large handwheel valves. The lever, which can be shaped from mild steel, should be supplied with a wooden handle. Such a lever is useful in the operation of a throttle valve.—C. WILLEY

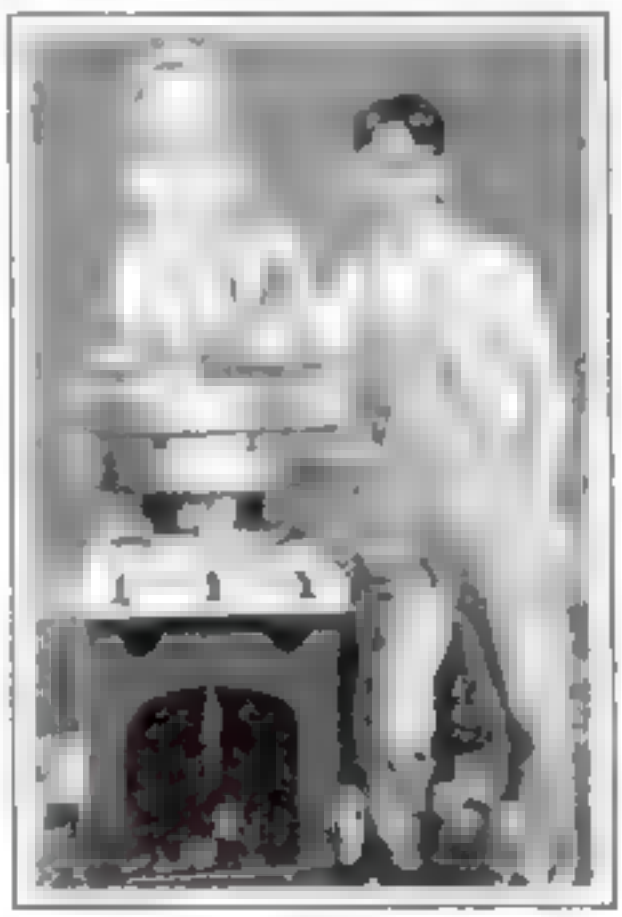
SHOCK-PROOF PLIERS

ELECTRICIANS who require pliers with insulated handles for working on "hot" circuits can easily make their own from ordinary pliers. Clean the handles carefully with lacquer thinner. When dry, dip each handle into a tall glass or bottle filled with lacquer of the chosen color. Hang the pliers up by a piece of string tied to the jaws until the lacquer has dried thoroughly. By repeating this process several times, a coat of insulating material of any desired thickness may be obtained. This is essentially a jacket of celluloid, which is a good insulator. For very high voltages, slip soft rubber tubing of suitable thickness over the handles while the first coat of lacquer is still damp, the lacquer will cement the rubber tightly in place.—D. D. TURNBULL

A QUICK WAY TO MAKE ODD SIZED REAMERS

IF ONE is called upon to make a special size reamer for an odd job, it can be done without difficulty by the following method: Obtain a piece of square drill rod, turn the shank, and mill a slight convex on all four sides to within about 1/32 in. of the edges. Harden and grind all sides until the desired size is obtained when the reamer is "miked" across the corners, and grind a slight nose to serve as a pilot.

When a hole is to be reamed with a hardened section as a guide for the reamer, more accurate results will be obtained if a knuckle-joint or floating driver is used.



LATHE CHUCK ADAPTED FOR USE IN SHAPER

ROUND work can be machined easily in the shaper if it is held in a lathe chuck adapted for the purpose.

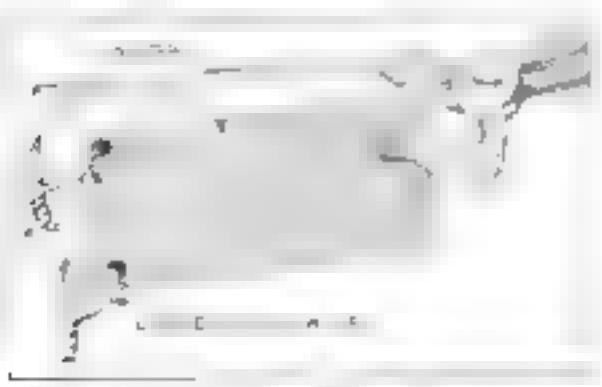
The adapting device illustrated above consists of two steel flanges, each 1 in. wide, welded to the ends of a short section of 8-in. pipe. Two semicircular slots are cut in the bottom flange to allow the necessary angular adjustment of the fixture. Two ½-in. studs, screwed into the base plate and extending up through the slots, are used to secure the bottom flange to the base plate, which in turn is bolted to the table of the shaper. The lathe chuck is screwed to the upper flange.

With the set-up shown, the writer in his machine shop in Hawaii has been able to machine many large pieces of round work without difficulty.—T. SAKAMOTO.

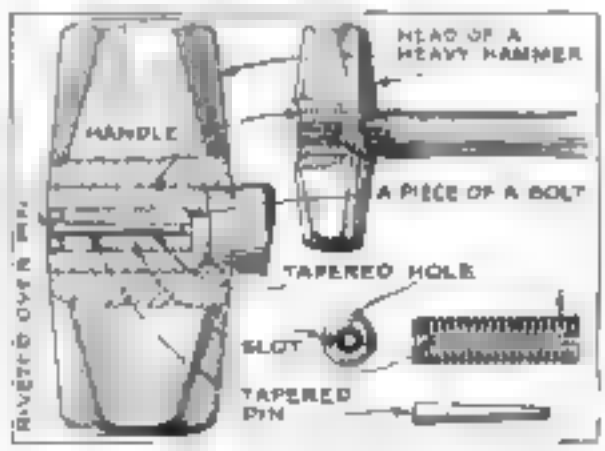
WIRE LOOPS PREVENT HARDENING CRACKS

IT HAD been our custom in the past when heat treating tool steel parts to fill all holes with fire clay in order to prevent the formation of cracks during the quenching operation. This often proved to be a time-consuming process, and in many instances we found that the fire clay came loose in the heating process.

We have found that wire tied in each of the holes in the manner illustrated below serves the same purpose. It not only has the advantage of being easy to apply but it will not come loose of its own accord during the process.—R. H. KASPER.



Wire run through small holes in work to be heat treated reduces the danger of cracking.



EXPANDING SCREW LOCKS HEAD ON SLEDGE

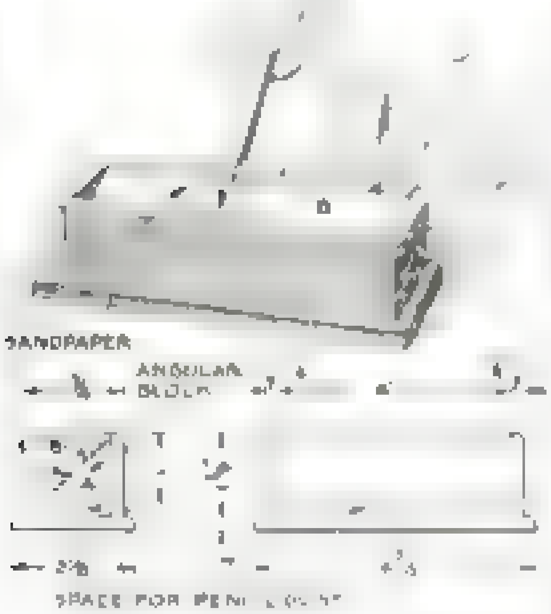
A SMART length of machine screw or bolt, if drilled, taper reamed, and slotted as shown, can be used with a taper pin as a wedge for fastening on the heads of heavy hammers and sledges.

To use, drill a hole in the head end of the hammer handle large enough to allow the length of screw or bolt to be driven in. Insert the screw and then drive in the taper pin. The pin serves to spread out the split end of the bolt and forces the threads into the wood. The pin can be held permanently in place by riveting over the edge of the bolt as indicated above.—F. J. W.

PENCIL POINTING BOX FOR DRAFTSMEN

THIS pencil sharpening device intended especially for draftsmen, may be left on a drawing board or in any convenient place without danger of soiling either the work, your hands, or the drafting instruments.

Running the full length of the box is a block of triangular shape, marked *A* in the accompanying drawing. To the upper face of this block is glued the sandpaper *B*. When pencil points are rubbed on the abrasive surface, the dust falls into the space in the bottom of the box instead of being scattered about as is the case if an ordinary sandpaper block or small file is used.—JOHN C. ZIMBECK



With a pencil pointing box such as this you can keep your hands and instruments clean.

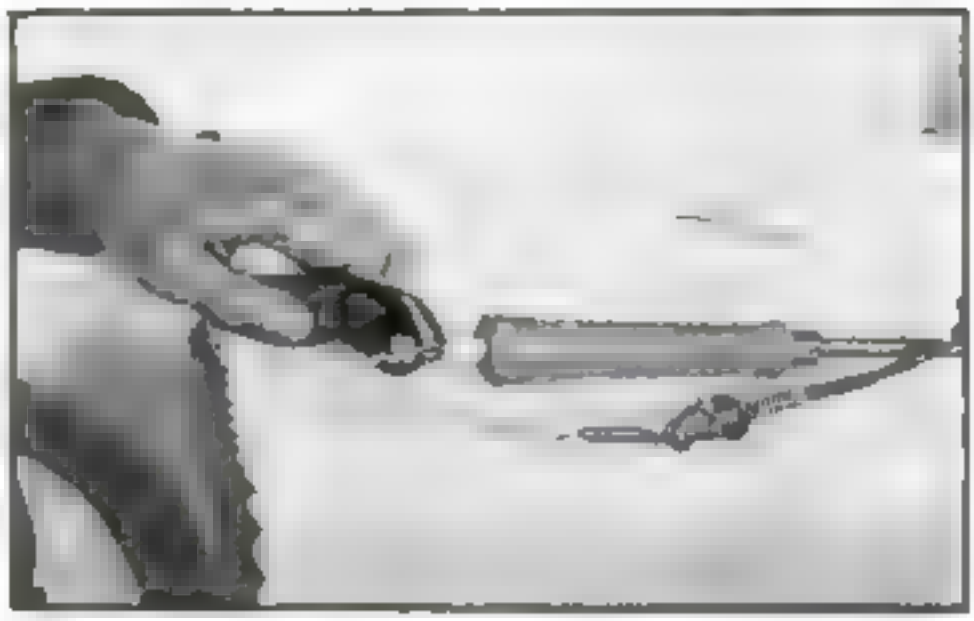
HOW TO SHARPEN SIDE CUTTING PLIERS

EVEN expert mechanics often have side cutting pliers in their tool kits which have very dull or possibly battered cutting edges. Just because the jaws cannot be separated so as to use a wheel to sharpen them is no reason why pliers should be allowed to continue in this state.

Carborundum in the form of a ½ by ⅛ by 3 in. stick such as is used for keeping an edge on pocketknives will sharpen pliers perfectly. Apply oil and rub with a slow motion as if filing. First use the broad face of the stone to straighten out the edges and test them by closing the pliers and looking through the slit at a light. Then proceed to sharpen the edges, being guided by the previous angle and your sense of touch. A thin keen edge is desirable for light wire cutting and a rather blunt thick edge for cutting heavy or hard stock.—LESTER C. PERTLE

The two processes necessary to reshape and sharpen pliers with dull or battered edges.

Repairing a Burned Out Electric Soldering Iron



At left The heating coil is carefully centered in the paper tube which acts as a form for the plaster. *Above* Connecting the coil to the extension cord.

ELECTRIC heating elements for various purposes can be made easily and inexpensively by embedding a suitable coil of nichrome resistance wire in a mixture of plaster of Paris, water, and sodium silicate solution (water glass). This method can be used, for example, when an electric soldering iron is burned out and a new element cannot be obtained.

Carefully remove and measure the wire in the old element and purchase a spool of nichrome wire of the same gage. Cut a piece to the length of the old element and wind it tightly about a pencil, afterwards running the return wire back through the center of the coil. Prepare a form for the plaster by making a paper tube slightly larger than the coil and fastening it upright on a block of wood with sealing wax. Center the nichrome coil in the tube, with the ends of the wire projecting out of the top. Then mix plaster of Paris in a solution of three parts water and one part water glass and pour it into the tube. The mixture should be quite thin.

Remove the paper after the plaster has set and bake the element until it is dry and very hard, then insert it into the iron through the handle. Fasten the connecting lugs on the extension cord to the element by crimping them tightly over the ends of the nichrome wire with pliers. The joints should be coated with a little of the plaster of Paris mixture and the element shoved into the metal tube, all being held in place with the threaded rubber bushing which is regularly a part of the iron.—GEORGE S. GREENE

A LEATHER BOOKMARK YOU CAN'T LOSE

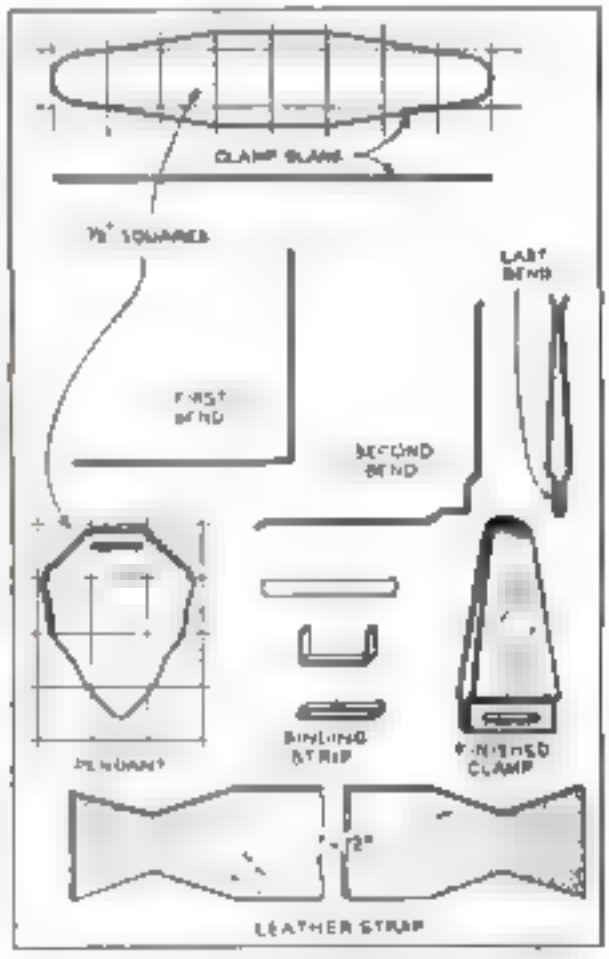
BECAUSE it has a special clamp at one end, this attractive bookmark is always where you want it. The clamp is slipped over the upper edge of the back cover of the book, so there is no danger of tearing the pages as is the case with bookmarks that are attached in any way to individual leaves.

A small piece of split sheepskin leather in almost any desired color may be purchased from your local bookbinder. From this cut a strip 1 in. wide by 12 in. long and make notches on either side of each end as shown in the drawing. The metal parts are made of spring sheet brass .015 in. thick. The clamp is cut in one piece, and after one side has been hammered with a ball pein hammer, it is bent to shape in the vise. The pendant may be cut in any shape desired; for example, an arrowhead, when hammered, is quite decorative. The slots for attaching these two pieces to the strap are made by drilling a hole through the metal at each end and making the straight cuts with a small cold chisel. The edges are then smoothed with a file.

At one end of the bookmark is an ornamental pendant of brass; at the other end is a clamp that grips the back cover.

If an initial or some other ornamentation is to be etched on the pendant, paint both surfaces and the edges with black asphaltum varnish except where you wish the metal to be etched. After the asphaltum is thoroughly dry immerse the pendant in commercial nitric acid for a few seconds, or until the design stands out. Remove the asphaltum with kerosene.

The two binding strips, which are made from the same sheet metal, are ⅜ in. wide and 1½ in. long and are bent as shown in the drawing. Polish all the pieces and give them a brush coat of banana oil or clear lacquer. Insert one end of the leather through the slot in the clamp, suede side out; then fold it back, slip one of the binding strips over the two thicknesses, and hammer the ends down. Trim off the surplus leather. Attach the pendant to the other end of the leather strap in the same manner.—DICK HUTCHISSON

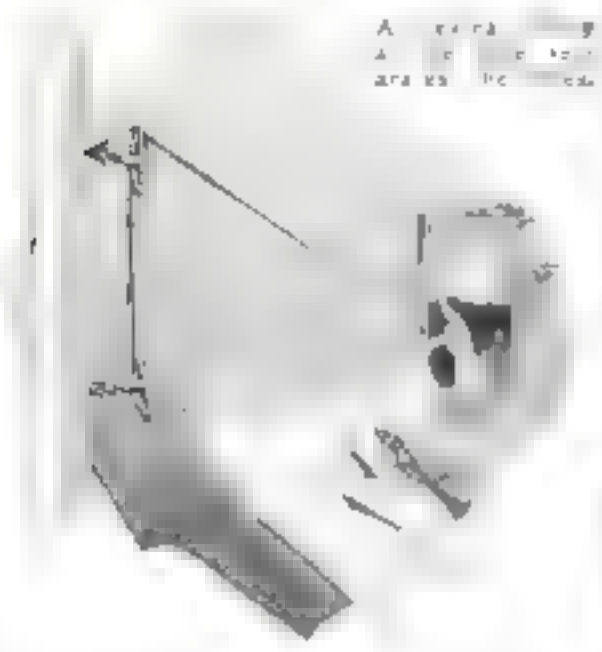


How to cut out and bend the clamp and make the pendant, strap, and small binding strips.

SUCTION grips, which are used so extensively on automobile ash trays, match holders, and sun shields as well as on household novelties, will stick better if they are rubbed on a cake of soap before they are wetted and applied.—W. R.

THIRD PULLEY IMPROVES OUTDOOR CLOTHESLINE

ORDINARY pulley clotheslines which run from the house to a pole in the yard often cause difficulty in windy weather because sheets, towels, and other linen wrap themselves around both the

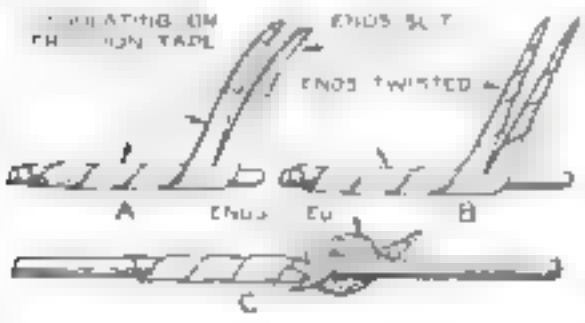


upper and lower lines. This can be prevented by using an extra pulley at the pole end as shown.

Anyone who has struggled to take in clothes during a violent storm will appreciate the value of this suggestion. Recently I saw an elderly woman having a strenuous tussle to get her washing off the line during a windstorm. In pulling the rope by sheer strength through the tangle of clothes, she must have done at least two or three dollars damage, besides exhausting herself. It was her experience that set me thinking of a way to solve this problem.—THOMAS MACE.

PERMANENT FASTENING FOR FRICTION TAPE

WHEN electric wires have been wrapped with insulating tape, the outer end usually loosens after a time because the tape has dried out. This is unsightly and may be dangerous if the bare wire is exposed. It is a good plan,



The end of the friction tape is split, both parts are twisted, and a firm knot is tied

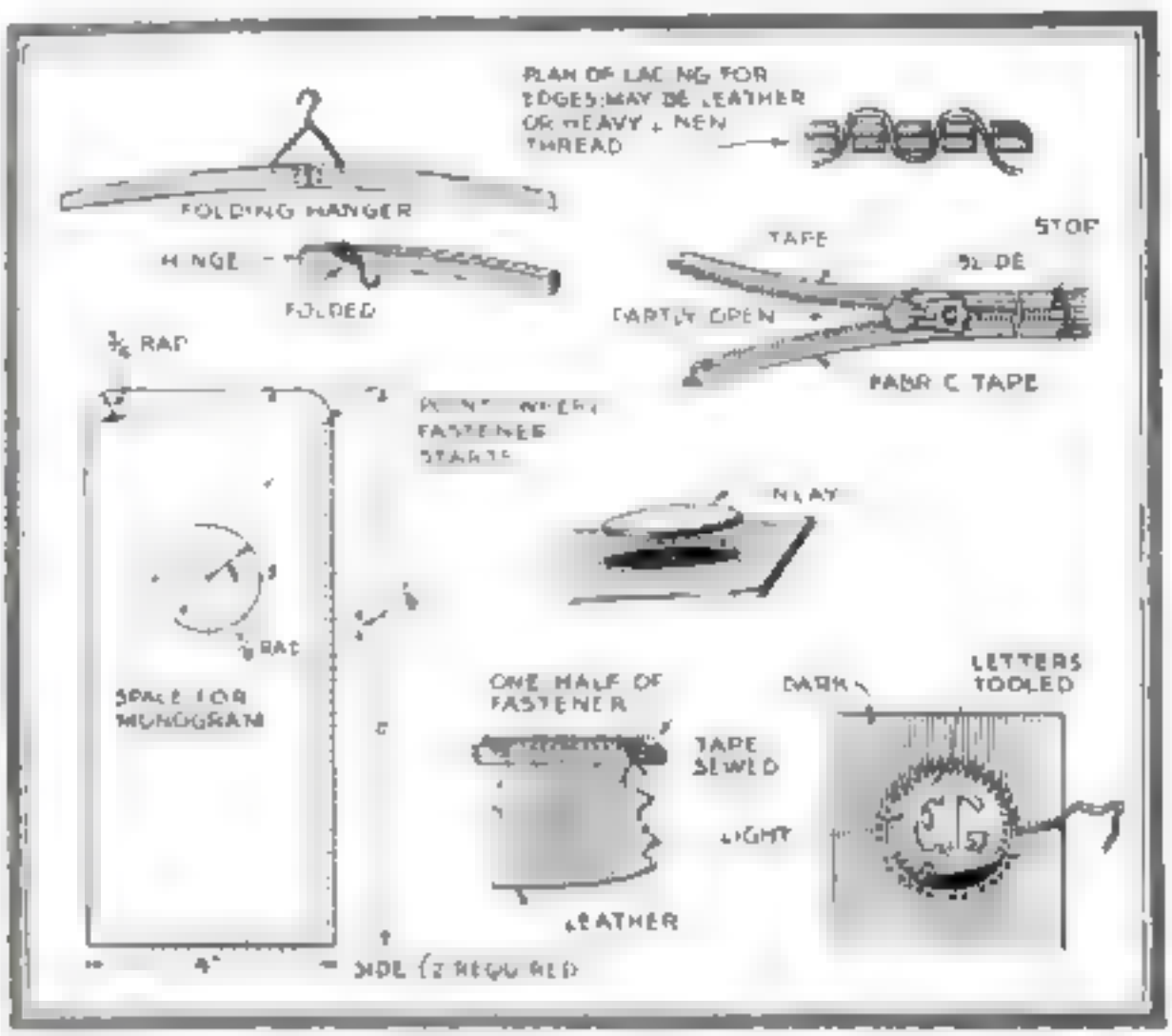
therefore, to split the end of the tape after it has been applied, as shown at *A*, and twist both parts as at *B*, carrying one of them around the wire in a reverse direction for one turn. Then the ends are tied as at *C*. This makes a wrapping that will not loosen.—E. W. WERNER

AMATEUR mechanics who work with aluminum or attempt to repair aluminum parts will find that the best cutting fluid or lubricant to use is kerosene.—L. B. R.

Inlaid Leather Case

Holds Folding Clothes Hangers

By F. Clarke Hughes



If you travel—and who doesn't in this day and age?—this novel clothes hanger case with tooled monogram and hookless fastener will prove a useful addition to your accessories.

THIS unusual inlaid leather case will gladden the heart of any traveler, for it holds three or more folding clothes hangers. The clothes closets in guest rooms rarely have a sufficient supply of hangers, and it is a distinct advantage to carry your own, especially since they take up so little room.

Before deciding upon the size of the case, purchase the hangers at a ten-cent store or at the notion counter of a department store, or make your own, if you prefer. It is suggested that a case large enough to hold a set of three hangers is most satisfactory.

Almost any leather may be used. Sheepskin or kid which are soft and very low in cost, will serve well for the body of the case, and a small piece of tooling calf may be used for the inlay. If a case of a better quality is desired, calfskin or other high-grade leather may be used. Only two pieces are needed for the body of the case, and these may be either laced or sewed together, as preferred.

The method of decoration is one that is new in this series of articles—the setting of one piece of leather into another in such a way that the contrasting colors and textures of the two leathers form the design. Very striking and novel effects may be worked out in this way, although there is some danger of overdoing the ornamentation; it must always be used conservatively. The inlay should be good tooling calf and in marked contrast with the stock used for the sides of the case. It is laced in position, as shown, the holes for the lace being spaced about ¼ in. apart. The inlay should be a good fit in the sidepiece.

Hookless fastenings may be obtained in a variety of style and lengths at nearly all department stores. The fastener is mounted on a fabric tape, which must be sewed to the leather. First glue the tape to the leather, then sew or lace it securely in place. It is best to sew the tape with a sewing machine along the very edge and afterward either sew with heavy cord or lace with leather, depending upon which method is used in making the case itself. The ends of the fastener will require skillful handling to avoid unsightly bulges.

When the case is completed, the exterior should be polished with high grade floor wax or shoe dressing.

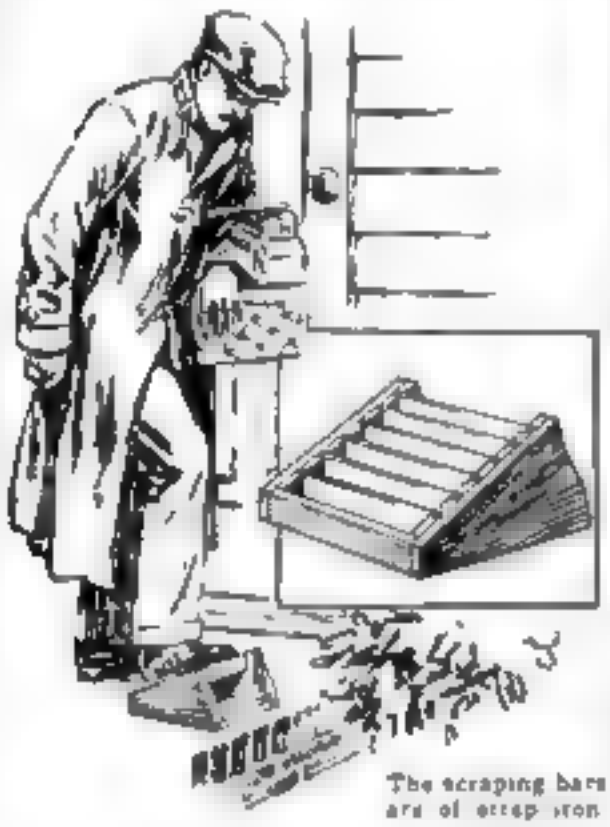
By using a tooled inlay of contrasting color, a pleasing two-toned effect is obtained. The inlay should be laced with leather of a matching color.

CUTTING GLASS DISKS

Glass disks can be quickly and easily cut in a lathe by means of an ordinary glass cutter clamped in the tool post. Cut out a piece of wood a trifle larger in diameter than the glass disk to be cut, and nail to this another disk of wood small enough to fit in the jaws of the lathe chuck. Spread a thick layer of glue over the outer surface of the larger disk and place the glass on this, pressing the two together. Next place a piece of wrapping paper over the glass and allow the edges of the paper to adhere to the glue on the wood disk. When the glue has dried mount the disks. Run the lathe slowly and feed the glass cutter in gradually.—L. B. ROBBINS.

PORTABLE SHOE SCRAPER EASILY KEPT CLEAN

THIS portable shoe scraper can be set beside the back door as a reminder for delivery boys and others to clean the mud from their shoes. As shown in the accompanying sketch, the scraper consists

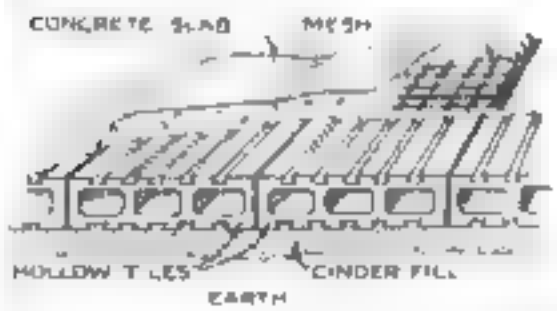


The scraping bars are of strap iron

of woolen sides and bottom with a grating of strap iron

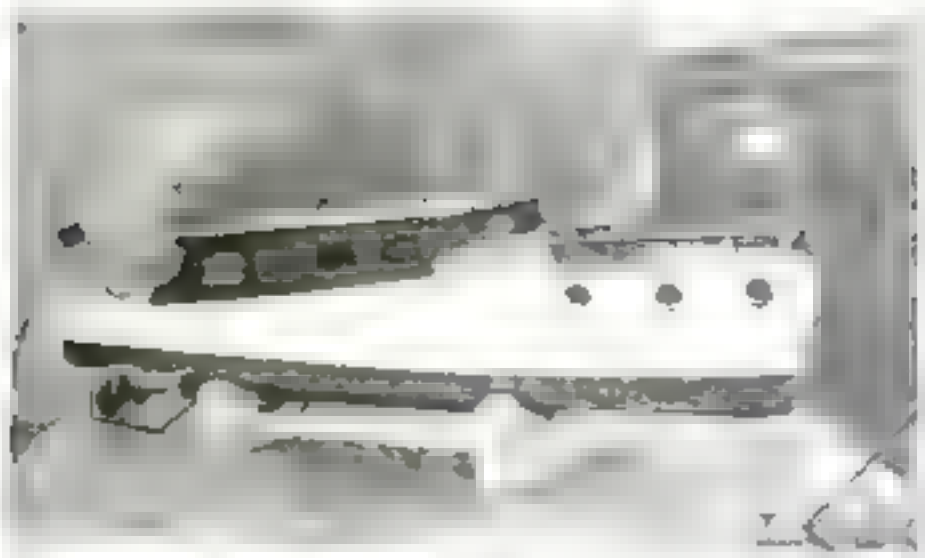
The sides are in two layers, the inner thickness being notched with a saw to take the ends of the strap iron. The top is made slanting to overcome the tendency of the scraper to tip up when in use The bottom extends the full length of the sides, and the back is left open to facilitate the removal of the dried and hardened mud from under the grating

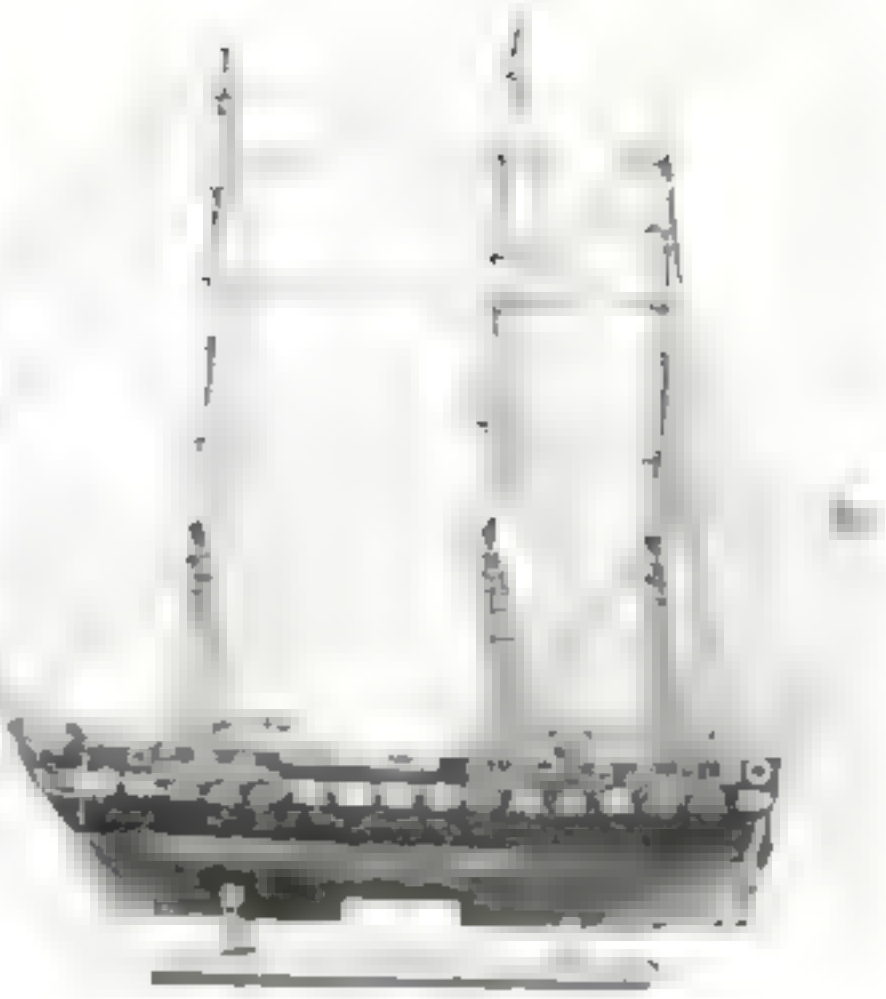
HOLLOW TILE BED GIVES DRY CONCRETE FLOOR



HERE is a method that has proved successful in providing a concrete floor with a bone-dry surface. Put down a bed of cinders or gravel as usual and tamp it well, then lay a sound course of 2- or 3-in hollow tile over the entire surface, and spread the concrete floor slab on top of this

This system is very suitable for the first floors of the new type houses which have only a small basement or none at all as well as for basements in damp sections For ordinary dwelling house construction the floor slab may be made as thin as 2 in if reinforced with wire mesh (wire fencing will do) to prevent cracking An architect's experience with this system in a number of installations is that a match may be struck on the surface at any time in any season.—JAMES THOMAS



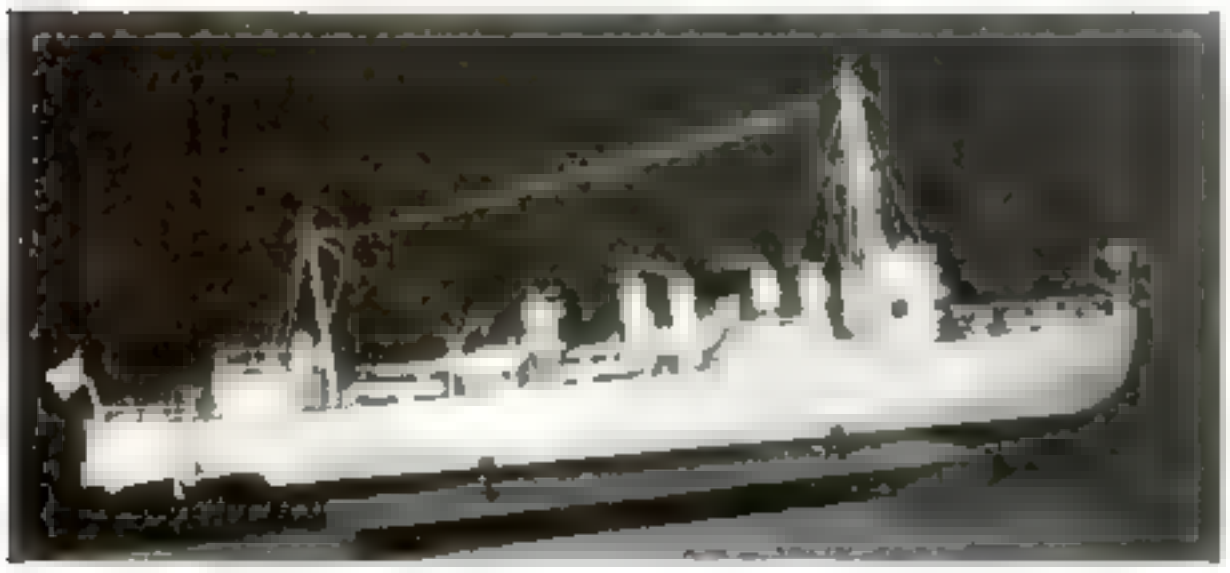


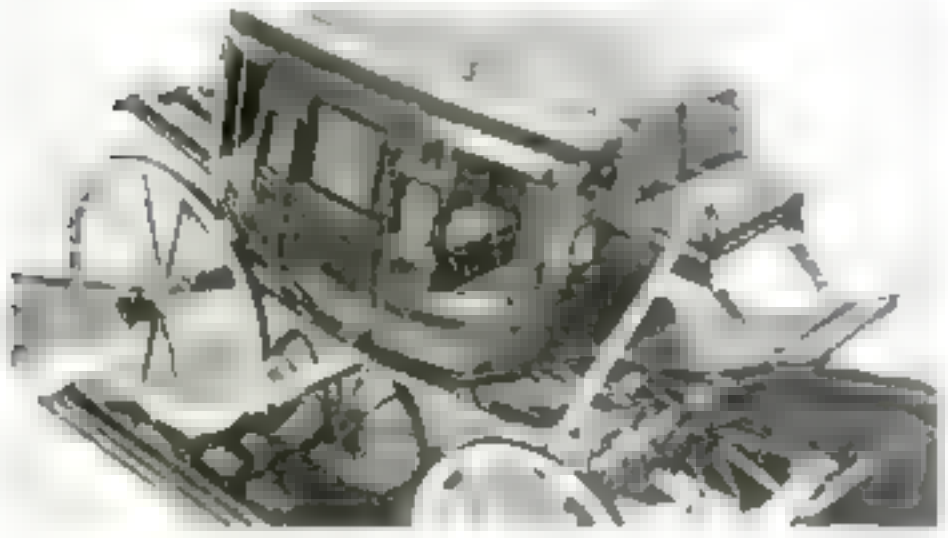
Our BLUEPRINTS

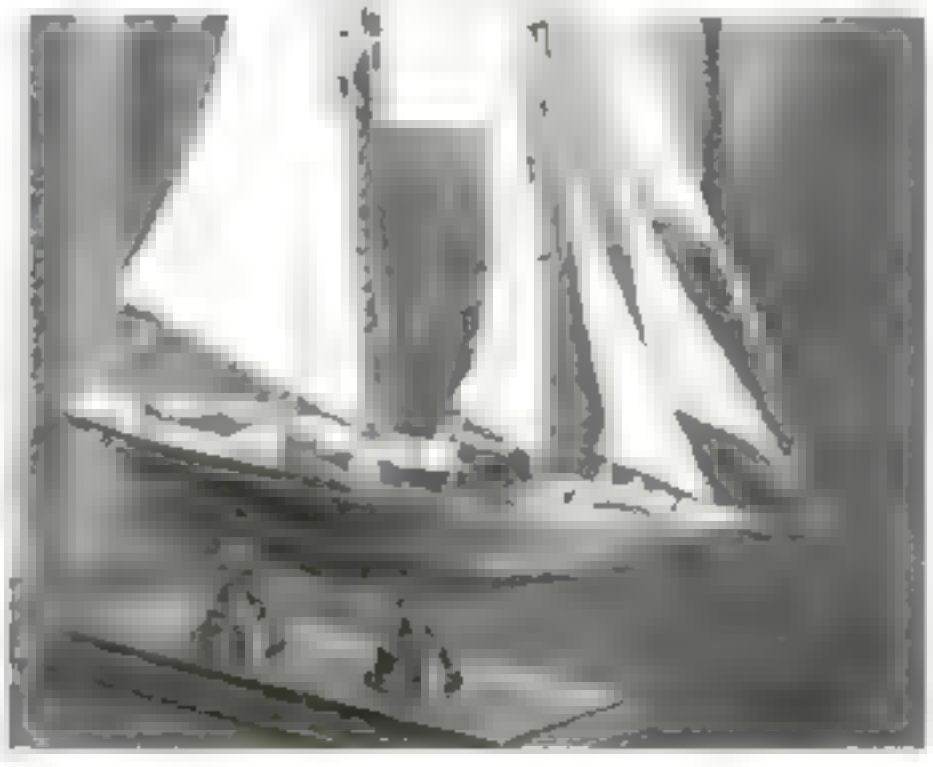
Valuable Christmas Gifts

from Inexpensive Materials

On [illegible] commission, the U. S. S. Constitution, better known as "Old Ironsides," is now [illegible] on the Eastern [illegible] of you have a chance to see this full-rigged [illegible] reconstruct a model of her from our B [illegible] Nos. 57, 58, and 59.







SAND-TRAY ENCOURAGES CHILDREN TO DRAW

AS EVERY young child likes both to draw and to play in the sand, this shallow sandbox will give many hours of pleasure. It makes drawing as enjoyable as sketching with a stick on a sandy beach.

The tray is made of wooden strips ½ in. thick and 1 in. wide, nailed together. The bottom may be ¼ in. thick wood.

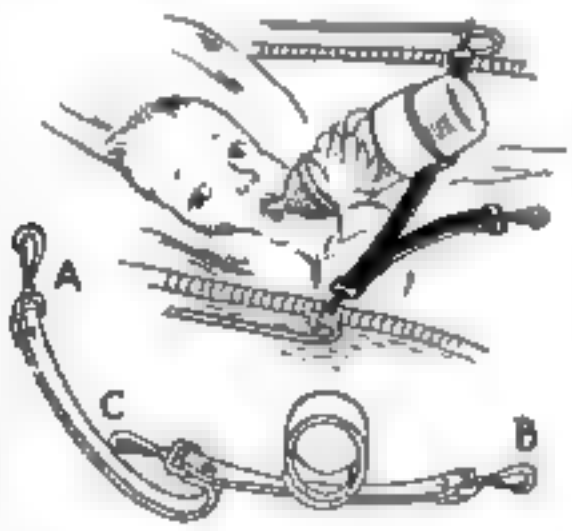
The drawings are made in the sand with a sharpened stick or stylus

heavy cardboard or wall board placed smooth side up. Paint the sides of the box light blue, and the upper surface of the bottom a dull black, or cover it with black paper or cardboard. A 5-in. piece of ¾ in. diameter white pine, tapered at one end, serves as a drawing stylus or pencil.

A few taps on the side of the tray will erase the picture, or the sand can be smoothed over with a scraper cut from cardboard or thin metal.—D. W. C.

HOLDER PREVENTS BABY FROM LOSING BOTTLE

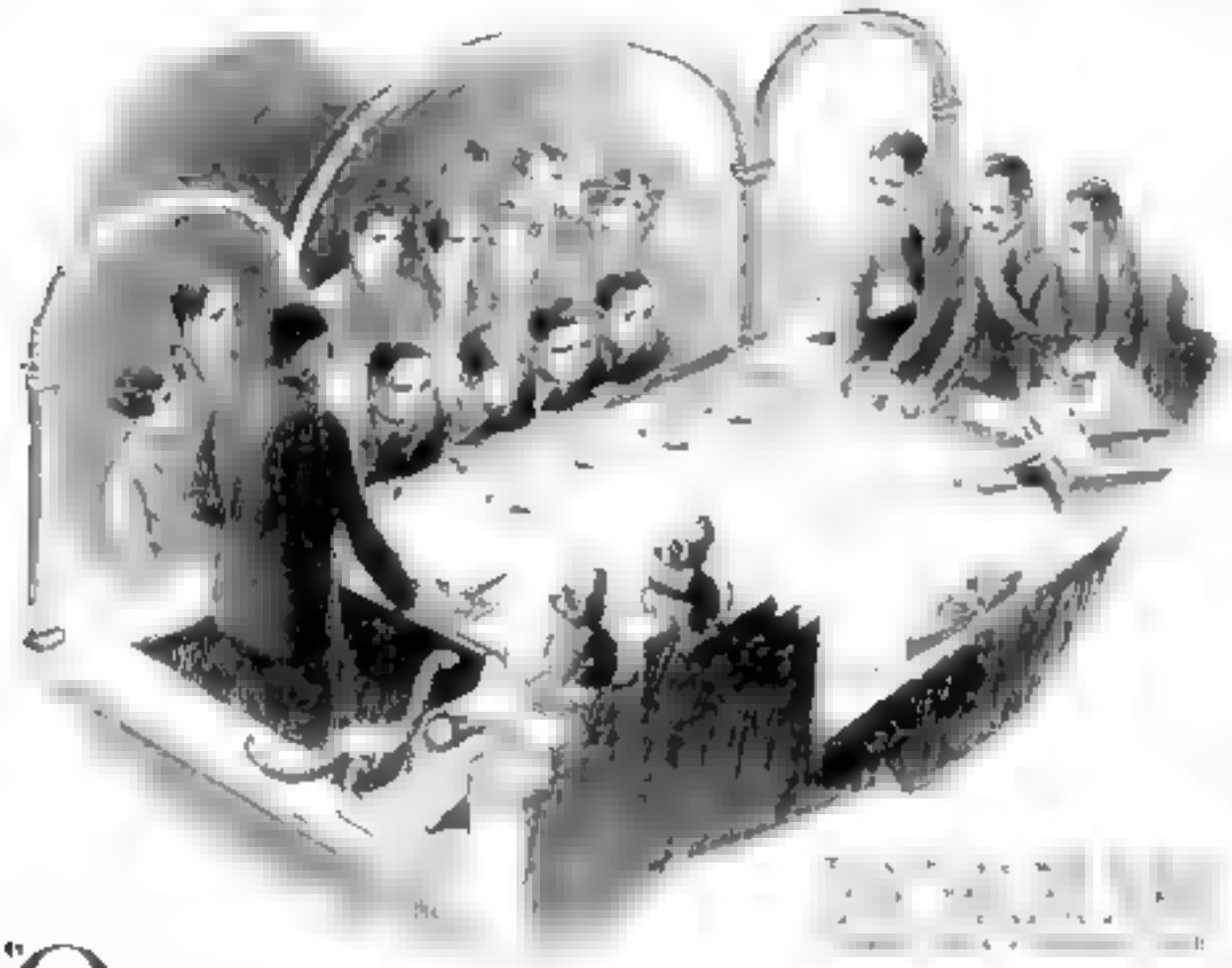
SMALL babies have a habit of losing their bottles and therefore have to be watched constantly. A mother can save this time and effort by making use of a bottle holder like that illustrated. A 1½



The soft rubber bottle holder is supported by a strap stretched across the carriage

in. strap of sufficient length to reach across the baby's crib is obtained, and snaps *A* and *B* are riveted at each end. Snap *C* is placed in a position which will allow the holder to be used with the narrower baby carriage. The bottle holder is a section of automobile inner tube, split and doubled over to fit the bottle snugly and riveted at both edges. Two slits are cut to allow the strap to be inserted through the holder. The holder then can be slid along the strap.—FLOYD FREEMAN

Indoor Model Yacht Racing



Easily built novelty for bazaars gives amusement to all and brings in a steady stream of nickels

By JACK HAZZARD

"OH JOHN! what on earth am I going to do!" burst out Sally as the man of the family doffed a streaming slicker and parked an equally wet umbrella in the hallway. "Those ladies at the 'Aid Society' wished the 'grab bag' on me for the church bazaar, and you know what that is! Costs lots to run, always nets a loss, and is a madhouse for the whole time. I'll go insane entirely. I just know I will."

John looked puzzled, annoyed, and a little bit worried. Then a sly grin crossed his face.

"Suppose," ventured he, "the boys and I take the job off your hands? You'll be big boss with nothing to do but look on."

"But—" commented Sally.

"But me no but's, young lady. Deal's made and job's half done. How about supper?"

• • •

The opening of the bazaar found a large booth advertising a yacht race where the modest "grab bag" usually stood—shimmering water, brightly painted yachts, miniature clubhouses, motorboats, and other appropriate fittings. The booth was presided over by jubilant members of the younger set, decked out in yachting uniforms of snowy duck and gold braid.

Every night of the bazaar found a crowd of youngsters eager to blow the boats across the pond, with scarcely a thought of the "grab" or prize going to each entry; and before the bazaar was over many older patrons arrived to "match blows" and joke the winner on his ability as a "blowhard."

The staging holding the lake was made from rough 1 by 12 in. boards supported on sawhorses, with pieces 2 by 6 in. nailed along the four sides to form a rough tray 6 by 6 ft. Miscellaneous boards were used to finish out the counters at each side. The far shores of the lake were rounded by the insertion of pieces of cheese box reënforced with small triangular blocks of wood.

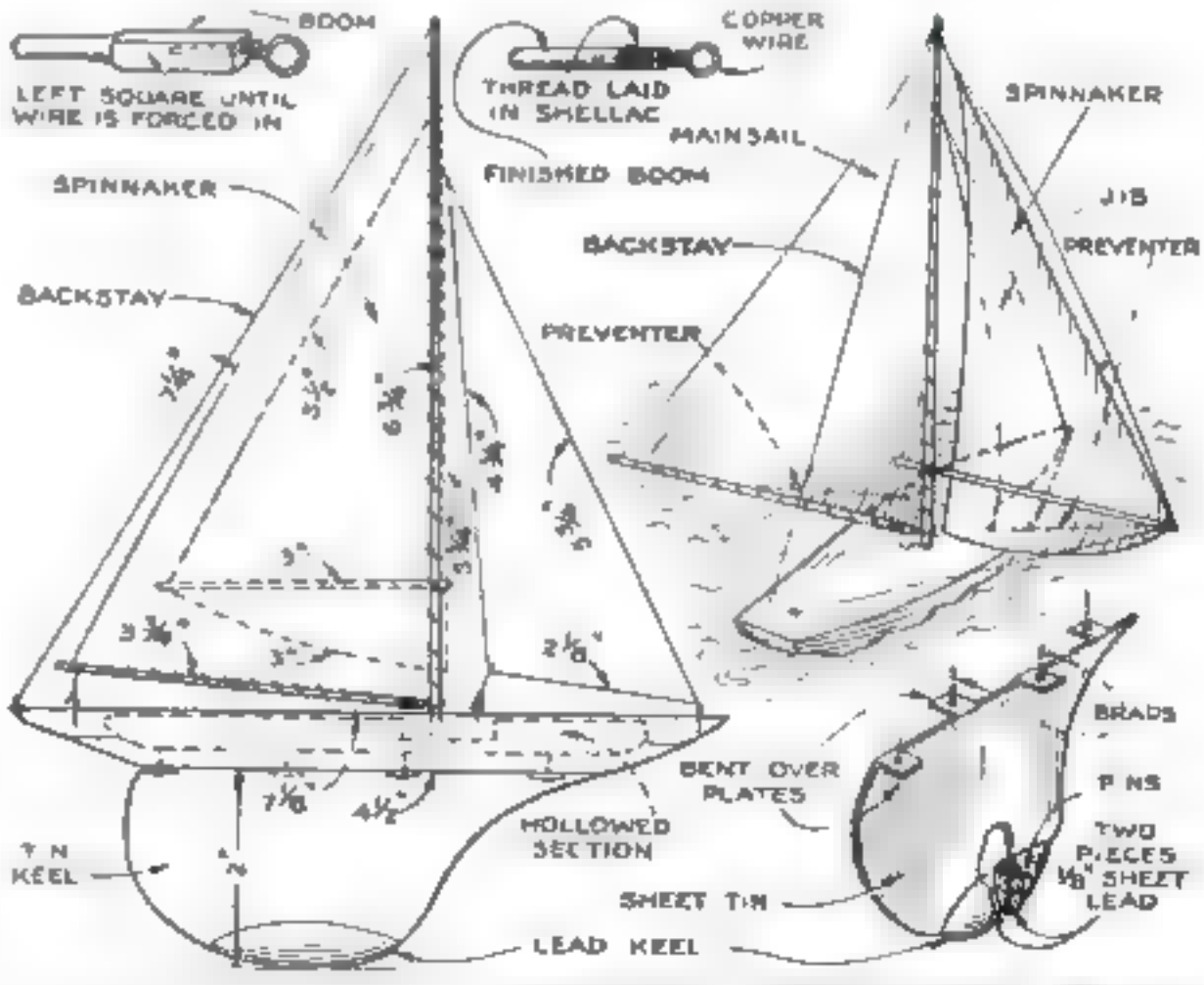
Five yards of 48 in. wide oilcloth of a cheap grade and bright blue color lined the bottom of the lake, the two breadths being joined with marine glue. The perpendicular sides were painted gray to simulate a stonework retaining wall.

A piece of wall board painted grass green and cut to fit the curved walls formed a deck to hold the clubhouses. Gravel walks and roadways were laid out in fine sand while the paint was still wet.

Cardboard houses, which formerly had graced a Christmas tree garden, served as the clubhouses when fitted with false fronts, fenders, floats, and landings. Weather-stained dowels, cigar boxes, peach baskets, and cheese boxes provided the materials. Small dolls and toy boats here and there helped carry out the general effect. Trees along the shore line were cut from cardboard and painted while ornamental bushes on the side walls were made by dyeing pieces of sponge a bright green and gluing them in place.

Four brightly colored bobbers or floats such as used by fishermen, were equipped with flags and lead weights to mark start and finish lines, those at the start being only a boat's length from the front of the booth and those at the finish being 4 ft. away.

The hulls were white pine, two ½ in. thick pieces (Continued on page 110)

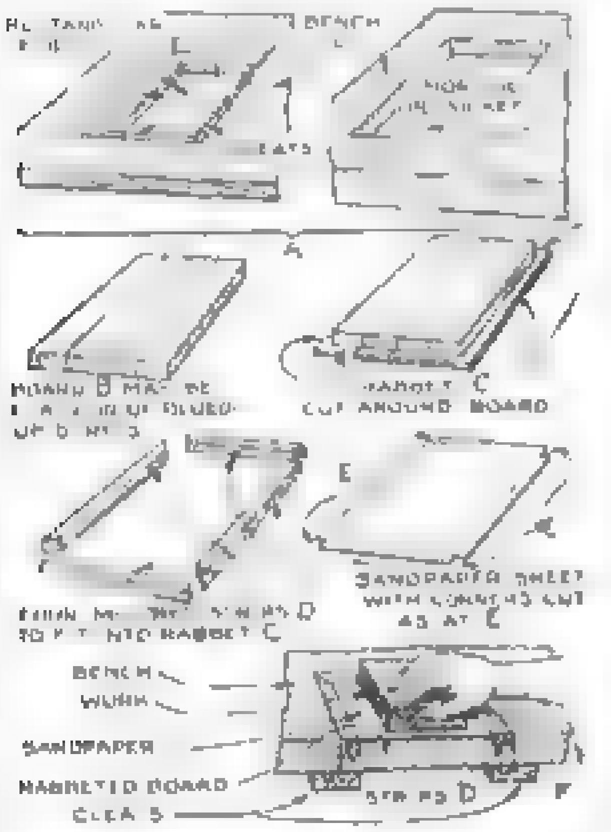


How the model yachts are constructed. The keel is made by pinning two pieces of ⅛ in. sheet lead on each side of a piece of sheet tin. Cut-off pins provide the necessary deck fittings.

SANDPAPERING SURFACE SET INTO BENCH FOR DELICATE WORK

IN THE home workshop there are often jobs which require a number of small, flat wooden pieces to be sandpapered. If the sandpaper is held in the hand, one is liable to knock off corners which should be left sharp. Even in smoothing such pieces on the disk sander, too much will be removed unless great care is taken. Such difficulties are eliminated by having a sandpaper surface at the bench like the one shown, the pieces to be sanded then can be held in the hand.

The dimensions depend upon the particular requirements of the work to be done and the size of the available sandpaper. The first step is to cut a hole



The sandpapering block is placed in a pocket so that it is flush with the bench surface

through (or recess in) the top of the workbench as at *A*. If the top is of heavy material, one can just mortise out a pocket; if thin, it will be necessary to saw out a hole and then run cleats around on the underside to support the surface board.

Next fit a board *B* tightly in the opening. To prevent the warping of this piece, it is well to glue up a number of narrow strips and then dress the piece down to the proper thickness. Around this piece, cut a border rabbet as at *C*. This can be cut out on the circular saw if available, or it can be done with hand saw and rabbet plane. Then get out four pieces just a trifle smaller in cross section than the rabbet, as indicated at *D*. These strips are mitered at the corners and forced into the rabbet so as to clamp the sheet of sandpaper as shown at *F*. The sheet of sandpaper itself must first be prepared by cutting away the corners as indicated at *E* and then folding it on the dotted lines. The mitered pieces can be held down with wood screws if desired.

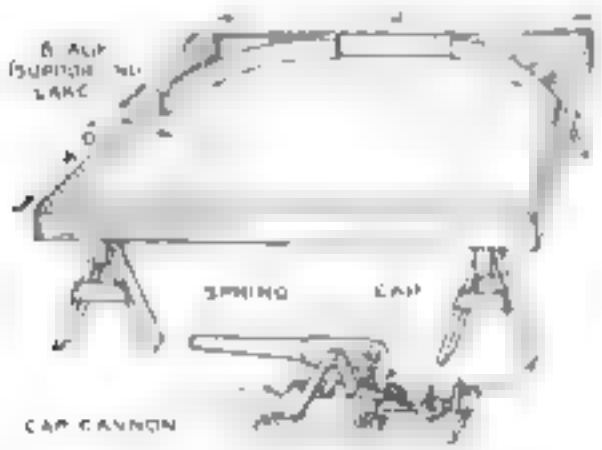
One of the advantages of a surface of this kind is that when sandpaper is not needed, it may be taken away, leaving the bench top flush.—JOHN E. HYLER

being used for each boat. After being cut to the deck outlines, the pieces were fastened together with double-pointed pins, whittled to shape, and then taken apart for hollowing the inside. The full thickness of the upper piece was allowed at the mast step as indicated in the drawings. When the parts were carefully fastened together with waterproof glue and painted, the joint was invisible and the hulls rode buoyantly because of the removal of more than three quarters of the weight.

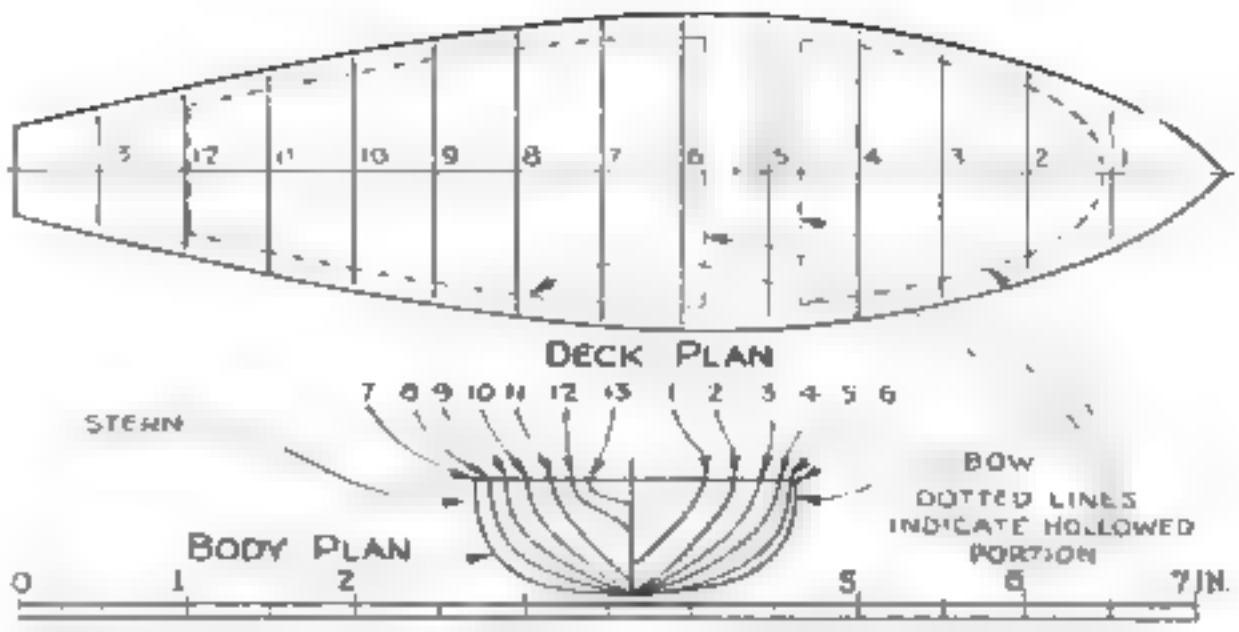
To assure stability and a straight course, a 2 in. deep keel of light tin, weighted with small pieces of lead, was attached to each hull with small brads.

Masts and booms were whittled from spruce, while the spinnaker booms were split from bamboo. Cut-off pins provided all necessary deck fittings.

The booms were fastened to the masts by means of small circlets of copper wire bent to shape and forced into the boom ends before the booms were whittled to their final size. Afterwards the ends were bound with thread and then shellacked.



The stage that holds the lake is made from 1 by 12 in. boards and supported on horses.



Deck plan and body plan of the hulls for the yachts. The hulls are whittled from white pine, two ¾ in. thick pieces, fastened together with waterproof glue, being used for each yacht.

Sails were cut from nainsook and, being very small, did not need to be hemmed. Instead, the shape was marked on the material with pencil and a stripe of shellac applied with a fine brush along the line on both sides of the cloth. When this had dried, the sails were cut. The shellac prevented raveling. All sails were laced to the spars before the masts were stepped.

The four yachts were painted differently, a green one named *Shamrock*, a white one *Enterprise*, a red one *Columbia*, and a blue one *America*.

Small cap cannons, left over from the Fourth of July, did the honors at the start and finish lines.

Decorating the booth proved a simple matter, for the bright yacht club flags, the limpid water, the gay yachts, the model clubhouses, the doll population, and the anchored fleets made quite a show to begin with. However, white sheeting was tacked around the base of the booth, letters of colored cardboard spelling "Yacht Race" were pinned on, and limber battens wrapped in yacht club colors were arched overhead and connected with a common center on the wall at the rear by means of long streamers of alternate colors. A length of new hemp rope made an appropriate border for the counter, and pictures of famous yachts adorned the wall.

The starter, at the left of the booth, also acted as clerk and accepted the entry fees—five cents a contestant. The judge at the right, fired the gun at the finish and awarded the prizes.

With receipts of twenty cents a race, it was possible to provide prizes a little better than the ordinary "grab" for the winner in each race, and the three other contestants received average awards. These prizes were purchased wholesale from a local novelty store.

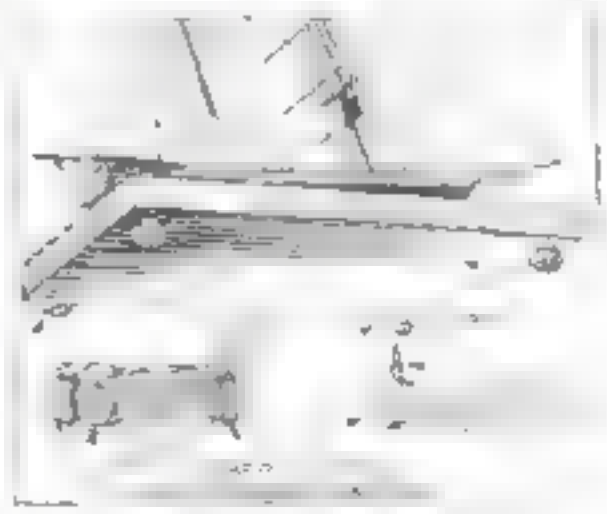
REVOLVING FARM GATE PREVENTS ESCAPE OF HORSES AND CATTLE

BUILT on the principle of a revolving door the farm gate illustrated allows anyone to pass freely yet keeps horses and cattle from escaping. The posts, which are 3 or 4 in. in diameter, are set 4 ft. 6 in. apart. Crosspieces are fastened to these at top and bottom with heavy spikes and lag screws, but before the top crosspiece is set in place, it is notched on one side a short distance from each end to receive the ends of the uprights. Through the center of the same piece a hole large enough so that a short length of ¾-in. pipe will fit in it loosely is bored halfway through; and a smaller hole (to make a driving fit for ¼-in. pipe) is bored in the bottom crosspiece. For the central upright, a fairly straight section is selected and cut about 8 in. shorter than the inside dimension from top to bottom of the frame. Holes are bored in both ends to take pins made of short lengths of ¼-in. pipe, the hole being a driving fit in the top and a loose fit in the bottom. One pin is driven tightly into the upper hole, and the other into the hole in the bottom crosspiece. Approximately 12 in. from the bottom of the centerpiece, two holes are bored at right angles to each other and about 2 in. apart. Two more holes are bored 24 in. from the first pair.

Four 4-ft. lengths of ¼-in. pipe are driven through these holes as shown. When the gate is ready for assembly, one or two disks of sheet metal having a diameter about the same as the hole in the bottom of the centerpiece are placed on the end of the bottom pin. The centerpiece is then set over this pin, and the top crosspiece fastened.—L. D. YOUMANS.

GARTERS YIELD RUBBER FEET FOR MODELS

NEAT rubber buttons to prevent the marring of polished surfaces by the bases of small models, statues, cribbage boards, or desk sets may be obtained from discarded garters or supporters. They are removed from the clasp by snipping their shafts with cutting pliers, and one is attached to each corner of the base with a carpet tack or small wood screw. Since the rubber is already countersunk, the screw or tack heads will be well below the surface.—W. L. FAUROT.

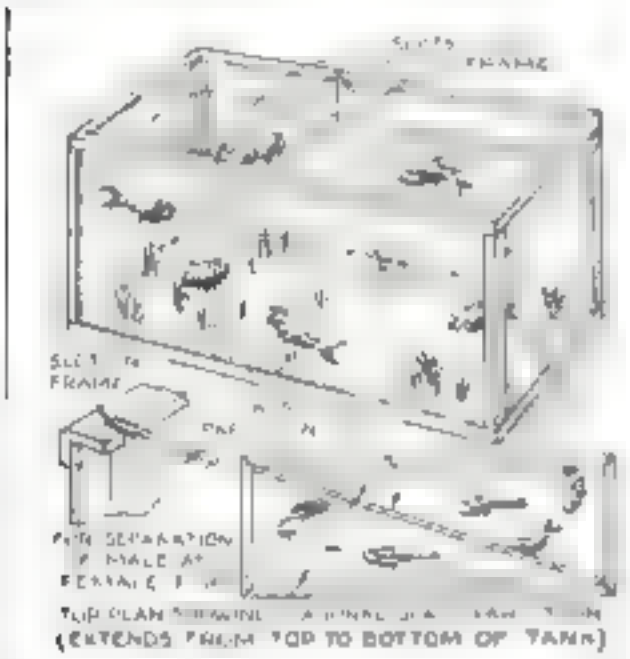


OBSTINATE stains on white (but never colored) clothing will often yield to an ink eradicator. Immediately afterwards wash the spot well with cold water.

INSERTING PARTITIONS IN AN AQUARIUM

THOSE who own aquariums often wish to place some special goldfish or other tropical fish in the same tank with ordinary fish. This can be done if the aquarium is divided by either of the methods illustrated

In the first, it is necessary to file two slots in the top edge of the aquarium to receive a sheet of single-thick window glass. Cut the glass slightly tapered to fit

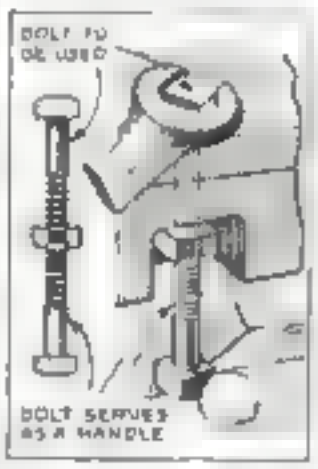


between the sides of the tank snugly and let it come flush with the top of the tank as some fish can jump over if the partition is too low

Divisions can be inserted 4 or 5 in short lengths, nested, to make an exhibition tank for several varieties and male and female fish can be separated in the same way

In the second method—for tanks that have no rim at the top in which slots can be filed—a long glass partition is pasted diagonally to divide the aquarium into two equal parts.—ARTHUR E. LANEMAN

STARTING SMALL NUTS IN AWKWARD PLACES



WHERE a bolt is in a position that is hard to reach, it is often difficult to start a nut on it. One easy way to accomplish this in many cases is to screw the nut for two or three turns on a similar bolt, which then can be used as a handle for holding the nut while it is being started on the first bolt. This is especially convenient on small stove bolts with nuts that are hard to hold with the fingers.—R. G. STONE.

ALL home owners know how essential it is to mark screens and storm sash plainly before they are stored away. My method is to nail on each a metal identifying plate (for example, FRONT ROOM LEFT) made on a machine of the ordinary addressograph type or on a nameplate machine found at most amusement parks.—JOSEPH KRAUS.

BLUEPRINTS

to Help You in Your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. These prints are the result of a pioneer effort begun by this magazine in 1922 to provide readers with authoritative drawings at a nominal price. This service has grown to be by far the greatest of its kind. It is conducted solely for your benefit, so do not fail to take advantage of it at every opportunity.

The blueprints are clearly printed on heavy paper 15 by 22 in. In the following list the blueprint numbers are shown in italic type immediately following the descriptive title. In ordering it is necessary to give only these blueprint numbers. Where the title is followed by one number only, the blueprint is on one sheet and can be obtained for 25 cents. Wherever there are two numbers, it means that there are two sheets in the set, and the price is 50 cents. Three numbers indicate that the set consists of three sheets and costs 75 cents. In a few cases, too, there is more than one project on a sheet. A coupon is given below for your convenience in ordering. When using the coupon, be sure to enter the numbers correctly.

Airplane Models

Bremen (3-ft. flying), *89-90* — $.50
Combination, 20-in-1, *125-126* — .50
Lindbergh's Monoplane (3-ft. Flying) *48* — .25
Rise-off Ground Tractor 3-ft. *50* — .25
Seaplane, Tractor 30-in. *87* — .25
Seaplane Morris (Record 12½ min.) *102* — .25
Single Stick Tractor 30-in. *82* — .25
Tractor, Record Flight 6,074 Ft. *104* — .25
Twin Pusher, Racing, 35-in., *86* — .25

Boats

Canoe Sailing Outfit *25* — .25
Outboard Racer [illegible] *128-129* — .50
Sailboat Motorboat, Combination [illegible] *121-122-123* — .75

Furniture

Bookcase, Modernistic, *88* — .25
Bookcase, Simple, *27* — .25
Book Ends, Modernistic, *100* — .25
Bookshelf, Modernistic, *100* — .25
Bookshelves, Hanging *77* — .25
Bookstand, Modernistic *47* — .25
Book Trough *48* — .25
Broom Cabinet *49* — .25
Cedar Chest, Mahogany Trimmed *1* — .25
Chair, Rush-Bottom *78* — .25
Chest of Drawers, Salem *3* — .25
Chests, Treasure *78* — .25
Clock, Grandfather *17* — .25
Desk, Colonial *21* — .25
Desk, Flat Top, *20* — .25
Desk, Sheraton Writing *4* — .25
Dresser, Welsh, *60* — .25
End Table, Magazine, *61* — .25
Kitchen Cabinet, *5* — .25
Kitchen Table Cabinet *2* — .25
Lamps, Modernistic *93* — .25
Mirror, Scroll Frame, *105* — .25
Pier Cabinet *77* — .25
Radio Cabinet, Console [illegible] — .50
Screens, Modernistic Folding *91* — .25
Sewing Cabinets, Two, *31* — .25
Sewing Table *1* — .25
Shelves and Lamp, Modernistic *7* — .25
Shelves, Corner *77* — .25
Smoking Cabinet, *2* — .25
Stand, Low Modernistic *1* — .25
Table, Gate Leg, *24* — .25
Table, Sheraton, *18* — .25
Table, Tavern, *105* — .25
Table, Tilt Top and Bench *11*
Tea Wagon, *13* — .25
Telephone Table and Stool *75* — .25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42* — .25
Five-Tube (Battery Operated) *54-55* — .50
Four-Tube, Battery Operated *41* — .25
Full Electric Headphone Set *120* — .25
One Tube, Battery Operated *103* — .25
Screen Grid Set, *109* — .25
Short Wave Converter Unit *117* — .25

Ship and Coach Models

Barque, Scenic Half-Model, *106* — .25
Bottle Clipper Ship in, *121-122* — .50
Clipper, Baltimore (8-in.), *92* — .25
Clipper—*Sovereign of the Seas*, *51-52-53* — .75
Constitution ("Old Ironsides"), *57-58-59* — .75
Covered Wagon, *128-125-130* — .75
Destroyer—U. S. S. *Preston* (31½-in. Hull) *125-126-127* — .75
Galleon, Spanish Treasure *46-47* — .50
Mayflower (17-in. Hull) *83-84-85* — .75
Motorboat 29-in. Toy *63-64* — .50
Pirate Galley or Felucca, *44-45* — .50
Roman Galley (19-in.), *118-119* — .50
Santa Maria (16-in. Hull), *74-75-76* — .75
Schooner—*Bluenose* *110-111-112* — .75
Sedan Chair, Queen's, *123-124* — .50
Stagecoach, Concord [illegible] — .5
Steamboat, Mississippi *94-95-96* — .75
Viking Ship, *81-82* — .50
Weather Vane Ship Model *66* — .25
Yacht, Sea Scout 42-in. Racing *106-107* — .50
Yacht, 20-in. Racing, *43* — .25

Toys

Airplane Cockpit with Controls, *114* — .25
Birds and Animals *30* — .25
Broncho Kiddie *14* — .5
Circular Saw, [illegible] — .25
Doll's House, *14* — .25
Doll's House, Colonial [illegible] — .25
Doll's House Furniture *7* — .25
Doll Press *113* — .25
Dump Truck *101* — .25
Electric Train *14* — .25
Garage *28* — .25
Fire Engine, *101* — .25
Jointer *113* — .25
Lathe *111* — .25
Lindbergh's Plane, *67* — .25
Play Table, Pullman, *21* — .25
Sprinkler Truck *101* — .5
Tea Wagon, *28* — .25
Tractor *101* — .25
Wheelbarrow Bunny *2* — .25

Miscellaneous

Arbor, Gate, and Seats, *9* — .25
Baby's Crib and Play Pen *25* — .25
Bench Hook, Combination *30* — .25
Boring Gage, *30* — .25
Garage, One Car, Pergola *7* — .25
Log Cabin (Three Rooms) *134* — .25
Puzzles, Six Simple Block *65* — .25
Swing, Porch, *10* — .25
Tool Cabinet *50* — .25
Trellises, Garden, *34* — .25
Workbench, *15* — .25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

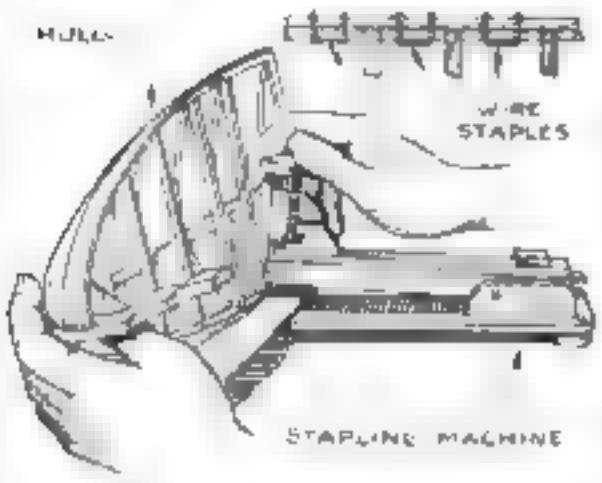
No. No. No. No.
No. No. No. No.
No. No. No. No.

I am inclosing [illegible] dollars [illegible] cents in payment, 25 cents for each number.

Name
Street
City and State

Note: Please print your name and address [illegible]

WIRE STAPLING MACHINE MAKES NEAT JOINTS IN MODEL WORK

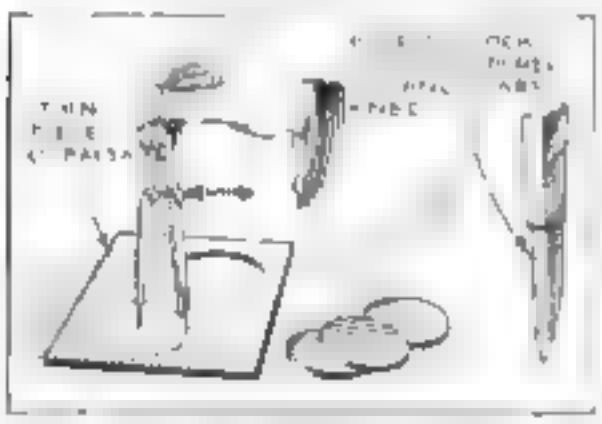


IN ATTACHING gunwales to the hulls of ship models, it is difficult to hold the thin strips in position while being shaped glued and fastened. For this and similar work, an ordinary wire stapling machine intended for papers may be used to advantage. It will make either temporary or permanent joints in any moderately soft wood up to ¼ in. in thickness.

The stapler, if used with light pressure will insert the wire without the danger of cracking the delicate parts that always exists when bank pins or small brads are driven into thin wood. Moreover, the staple with its two points will hold the parts more securely in the desired position.

If the material is thinner than ¼ in. the staple will protrude. The points may be clinched until the glue has set, when they may be filed or clipped off, or the entire staple may be removed if it is not a permanent fastening.—W. L. F.

DISK CUTTING TOOL FOR BALSA AND PAPER



Using a cheap pair of machinist's dividers as a tool for cutting disks of balsa wood.

FOR USE on models I was recently building, I needed some small wheels of balsa wood and a number of paper disks of various sizes. Cutting them by hand with a knife or scissors was not satisfactory, so I cut the tip off one of the legs of a cheap pair of machinist's dividers and soldered a piece of clock spring to the leg as shown. After sharpening the end of the spring with file and stone, I found that it cut smooth disks and held its edge very well.—JOHN RIDGWAY, Jr.

PICTURES on the walls of houses near busy thoroughfares are often shaken out of alignment by the continual vibration. This can be prevented by driving a pin or small nail into the wall at each side of each picture near the bottom.—W. C. R.

How to Test

Shellac for Shop Uses

[illegible] antifouling and anti[illegible] paints

By W. H. HAMMOND

BECAUSE of its insulating and waterproofing qualities, shellac is too valuable a material to the boat owner and shopman for him to take a chance with inferior grades.

Dry flake or ground shellac, complying with Government requirements for Grade A, makes an ideal ingredient for the boat owner to use in the standard formulas for antifouling and antirusting boat-bottom paints. It is also the best possible base for alcoholic varnish to use in the shop on electrical coils and apparatus.

Poor grades of gum will take in the container when mixed in these formulas or form a chalky, nonprotective coat on the boat surface. They are also likely to cause insulation breakdowns when used in the shop by the amateur electrician or wireless fan. The simple tests to be described conform to standard practice in testing laboratories.

The following formula for antifouling paint is the product of long experimentation by Navy master painters and chemists. It represents the most effective means yet discovered of keeping down the growth of barnacles, weeds and other water organisms on boat bottoms. To test the suitability of a brand of shellac prepare a small lot of the formula in a 1-pt. friction top can.

Antifouling Paint

Shellac, dry, orange	91 grams (2.15 oz.)
Alcohol, denatured, 95%	236 cc. (8 fld. oz.)
(wood alcohol strength)	
Zinc oxide, pure, dry	62 grams (2.2 oz.)
Indian red, pure, dry	62 grams (2.2 oz.)
Mercuric oxide, pure, dry	28 grams (1.0 oz.)
Pine oil	59 cc. (1.32 fld. oz.)

All the materials can be obtained at a paint store except the mercuric oxide (especially poisonous to marine growth), which can be purchased at a pharmacist.

Allow the shellac to stand in the alcohol for twenty hours until dissolved before adding the other ingredients. Stir vigorously, cover and shake for five minutes. Allow to stand in the can for seven days. Then remove the cover and stir with a stiff instrument. The paint should be easily broken up by gentle stirring to form a uniform mixture of good brushing quality, and it should form a satisfactory film when brushed on a copper or wood panel. The formation of a hard, gummy mass is sufficient evidence that the shellac is not suitable for use in this formula.

Antirusting paint makes an excellent protective coating for iron sheet, steel boltheads, and metal fittings that are exposed to water and dampness. To test a shellac for suitability for use in its preparation, make up a small lot as before.

Antirusting Paint

Shellac, dry, orange	30 grams (1.05 oz.)
Alcohol, denatured, 95%	236 cc. (8 fld. oz.)
Zinc dust	30 grams (1.4 oz.)
Zinc oxide, American Process, dry	98 grams (3.8 oz.)
Pine oil	59 cc. (1.3 fld. oz.)

Mix, stand, and then test in precisely the same way as the antifouling paint. If all the ingredients but the shellac are pure, the presence of a hard, gummy mass, and the formation of an unsuitable film when some of the paint is brushed on a metal or wood panel, is proof that the shellac is valueless to the boat owner.

The two commonest impurities in shellac which affect its quality for general shop purposes are sticks and dirt and

rosin. Government standards allow no more than 1½ percent of the former, which is a natural impurity, and none of the latter, which could be present only through dishonest adulteration.

Sticks and dirt in shellac flakes can be detected by measuring out about half a teaspoonful of the material, placing it in a dry glass bottle, adding enough denatured alcohol, preferably hot, to form a thin varnish, allowing it to stand until dissolved, and then examining the bottle against a good light. Grade A shellac should have hardly enough insoluble matter to be detected by this test

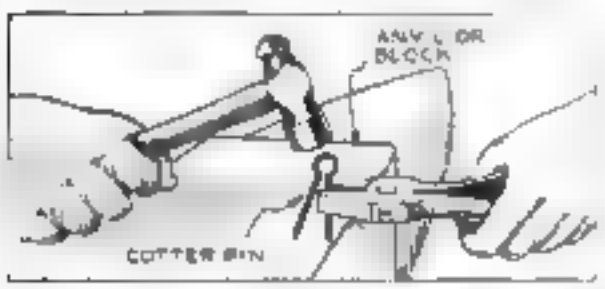
Rosin, which is a more serious impurity, is tested for chemically as follows. Obtain a dime's worth of a reagent which chemists call acetic anhydride. This can be bought at a drug store, chemical supply house or the laboratory of the local high school

Place a large pinch of the shellac flakes and about a teaspoonful of the acetic anhydride in an old cup or dry test tube and allow to stand for fifteen minutes to dissolve. If the acetic anhydride evaporates, add enough more to keep the solution thin. Since the reagent has an offensive odor, the test should not be conducted in a closed room or in living quarters.

Place about half a teaspoonful, measured roughly, of from 30 to 50 percent cold sulphuric acid (oil of vitriol) in another test tube or old cup and then add to it exactly one drop of the acetic anhydride solution of the shellac, allowing the drop to run down the side of the tube If rosin is present in the shellac, a fugitive violet color will immediately appear and then disappear in the acid. This violet color should not be confused with a dirty brown color which slowly forms from the action of the acid on the shellac itself several seconds after any tint due to rosin has disappeared

A shellac that is to be used in varnishing the woodwork of electrical instruments should make a good appearance Therefore it must not be used on the same job with the remnants of some other lot of shellac without a preliminary careful matching of the colors of the two lots This matching can be done easily by flowing a thin solution of each over a glass plate and when dry comparing them against a good light

HOW TO CLOSE THE LEGS OF OLD COTTER PINS

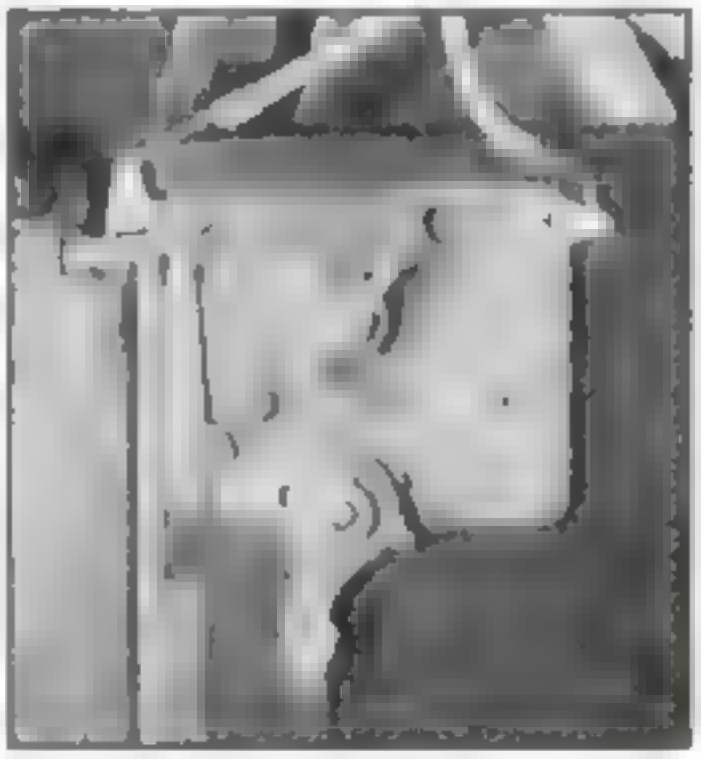


IN REPLACING old split cotter pins, it is often difficult to squeeze the legs together so that they will enter the hole An easy way to do this, provided the legs are merely separated and not badly bent, is to set one leg vertically on the vise or any block of metal and tap the top lightly with a hammer. The legs will then close until they are as tight as in a new cotter pin.—J T WATKINS

Camera Shutter Switch SETS OFF *Flashlight Bulb*

By HERBERT WOOLSEY

Flash-bulb attachment for camera of graflex type. To avoid wasting bulbs when first adjusting the switch, use a small flashlight lamp for testing.



ELECTRIC flash bulbs for photography can be used much more effectively if you make a simple attachment for your camera that sets off the flashlight automatically when the shutter is operated. All you need is a camera with the proper kind of shutter, a few feet of electric lamp cord, a photoflash lamp reflector with attached battery case, and a few screws, bolts, solder and odds and ends.

For a focal plane shutter such as is shown above, the switch consists of a small piece of spring brass or bronze fastened to a piece of insulating material that is held by one of the shutter plate screws. The spring contact is arranged so that the small lever which moves back when the shutter is released will strike it.

On a shutter with a setting lever, a spring paper clamp is used to attach the contact arm.

Of course, the tip of this lever must be free from paint or any other coating that might prevent good electrical contact. Solder one wire of the lamp cord to the spring contact, and attach the other to a soldering lug held firmly by one of the mounting screws on the shutter plate. Connect one wire to the threaded metal ring at the bottom of the battery case, and the other end to the threaded metal part of the lamp socket at the top.

For a shutter having a setting lever as shown at the left below, arrange a spring brass or bronze contact so that the lever passes it midway in its return to the [illegible] position after the shutter has been released. One wire from the flash-lamp battery is attached to this contact, and the other to a small clip which can be snapped on any convenient projection of the shutter.

An easy way of mounting the spring contact is to attach it to a piece of wood or other insulating material that has been fastened securely to a small spring clip or paper clamp. Usually you can attach the clamp to the edge of the shutter support and adjust the contact position by moving it up or down. The setting lever, as it passes, should make good electrical contact with the spring. The clamp supporting the spring contact can be used as the means of attaching the second wire to the shutter frame, if desired.

On such a shutter as that illustrated the shutter leaves are at the open position when the lever has completed half of its return journey. It should contact with the brass or bronze strip just before it reaches the midway point, and maintain contact almost to the end.

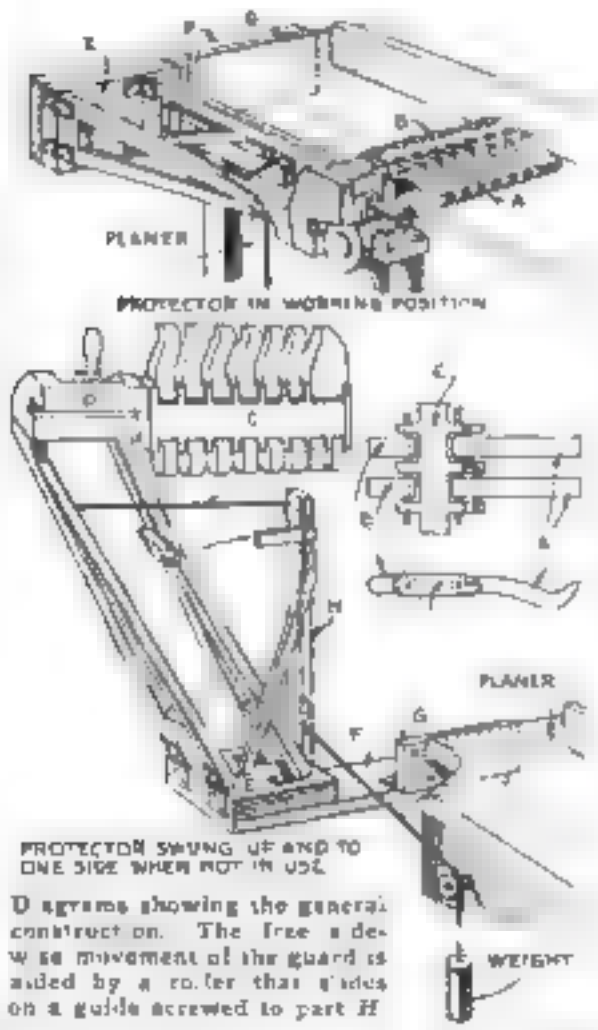
SIMPLE WOODEN GUARD MAKES BIG JOINTER SAFER TO USE

AN EFFICIENT safety guard for a large jointer or hand ("buzz") planing machine can be made easily by any experienced woodworker. The design illustrated has the advantage of providing absolute protection both in front of and behind the cutter, yet the guard can be instantly raised out of the way.

Note that the front arms *A* and the back ones *B* differ in size and shape. Both are

Boards to be surface-planed pass underneath the guard as shown; boards to be jointed on the edge are pushed by the end of the guard.

pivoted to the projections on the holder *C*, and the front arms have stop pins to prevent them from dropping down too far. Part *C* is secured to *D* so that when *D* is resting on the planer, *C* is about 2 in. above the table. Two light triangular supports are built up and attached to *D* and *E* with hinges. Part *E* is fastened to board *F*, which in turn is hinged to *G*, and *G* is fastened to the end of the planer table. A heavy cord or wire cable *J* is rigged over pulleys and tied to a weight in order to pull the guard over the planer when it is lowered for use. A small support is placed on the side of the planer to hold the end of piece *H* when the guard is down.—JAMES H. SUDDUTH



Diagrams showing the general construction. The free sidewise movement of the guard is aided by a roller that glides on a guide screwed to part *H*.

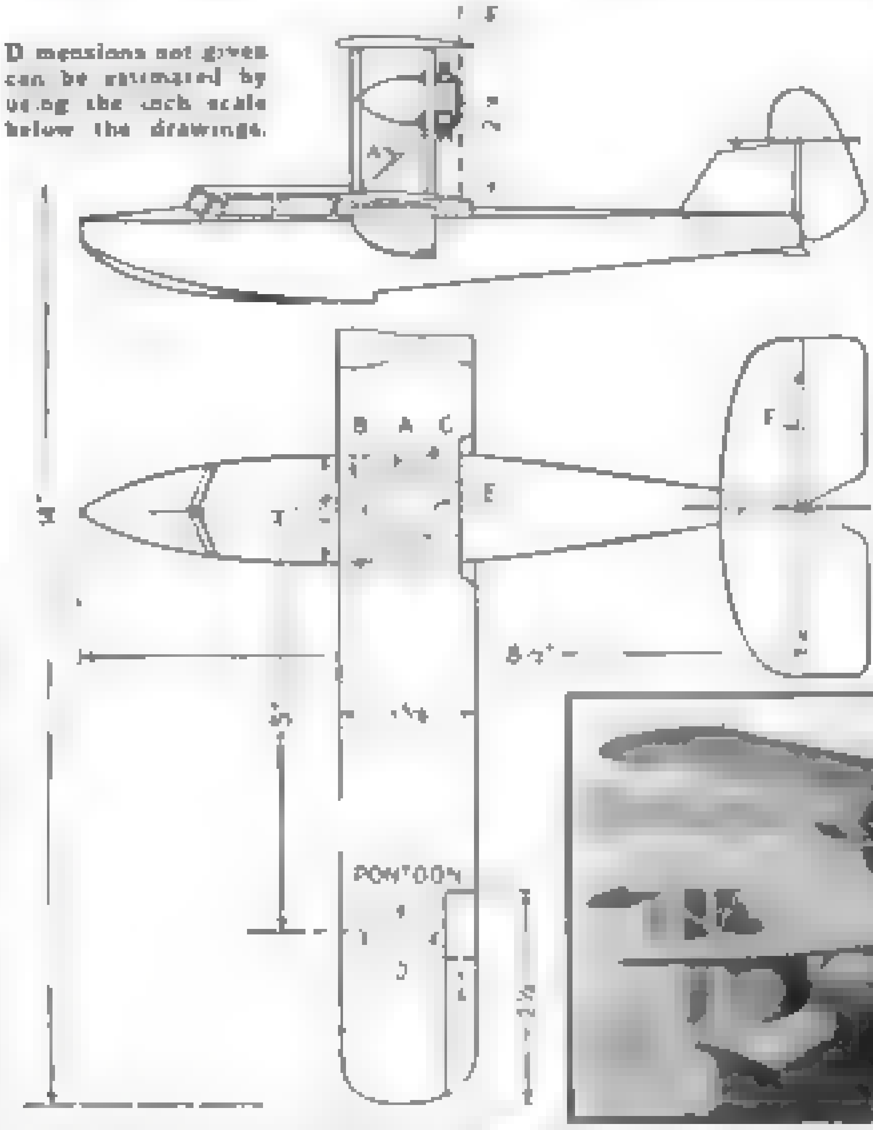
Whittled Model of Graceful Flying Boat

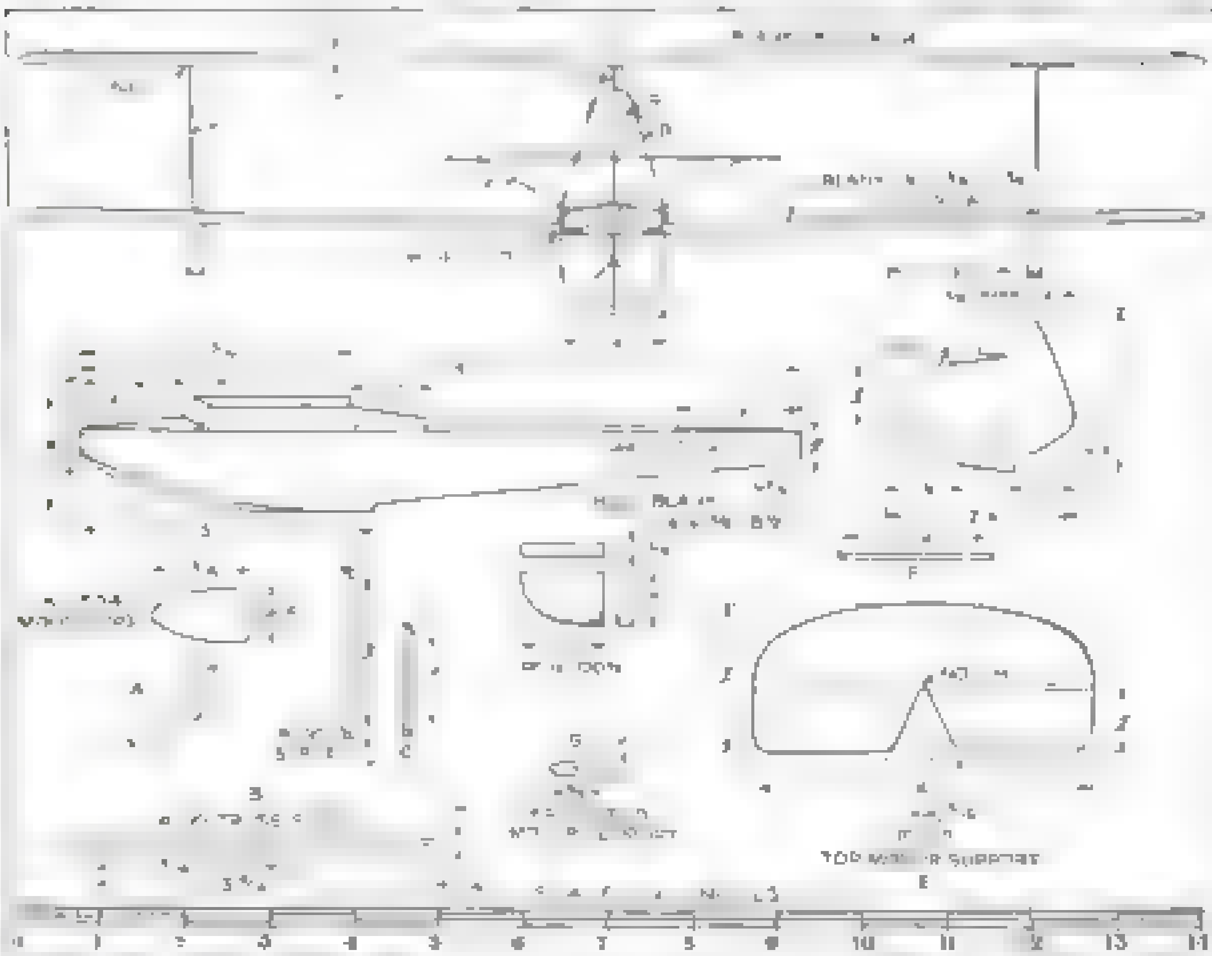
MODEL makers will enjoy building this toy Boeing flying boat model because of its simplicity of design and pleasing lines. First whittle the hull from soft pine. Round off the top sections and sandpaper the whole smooth for painting. Saw a slot in the rear end to take the vertical tail unit, which is held in place with one nail. The horizontal tail is fastened to the vertical unit by means of a notch and one rivet; and two thin sheet metal struts *F* hold it rigidly in place.

Make the lower wing in one piece like the upper, then cut it in two and attach each half to the hull with wire studs or pins. Thin metal ⅛ in. wide is used for the struts *D*, the ends being bent and drilled for small nails. The wing-tip pontoons are held with brads driven down through the wing.

The streamlined motor mounting is mounted on two struts *C* and two struts *A*, and there is a short one *E* on top, fastened to the middle of the upper wing. The cylinders are represented by nine 5/16 in. long sections of 3/16 in. diameter bolts.

This model will look well if painted with the following colors. Hull, dark red; top of hull, yellow; both wings and struts, buff; vertical fin, red; rudder, yellow, horizontal tail buff; pontoons, red; motor mounting buff; motor black, propeller, aluminum; and windows aluminum.
—DONALD W. CLARK.





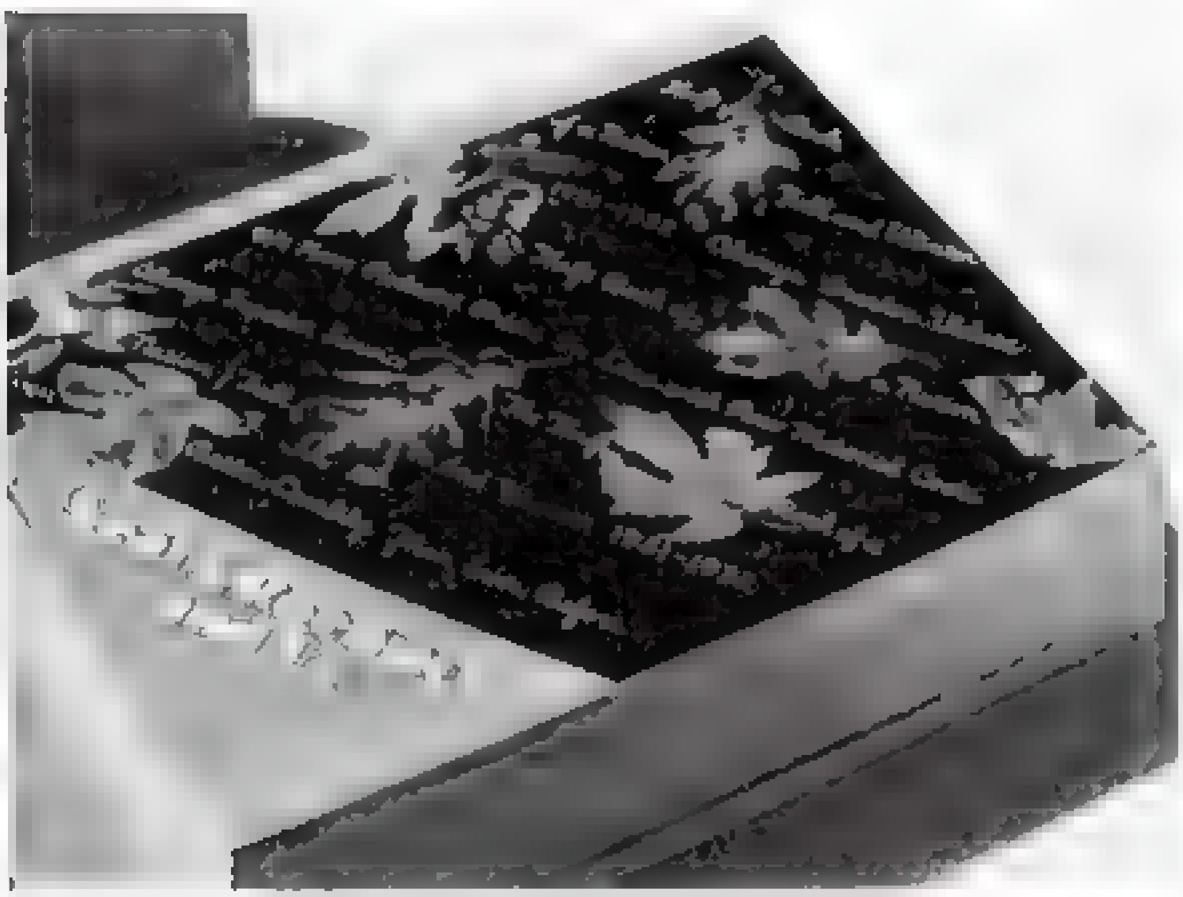
Working drawings for a Boeing flying boat model and a photo of one of the ships, which are used extensively on the Pacific coast for mail carrying, patrolling, and exploring.

SEARS, ROEBUCK and CO.

. . . . *a timely*

Announcement

to every family in the United States



Never in all of their existence have Sears, Roebuck and Co. bought merchandise at *such favorable price levels.* We know that the real value of our goods is greatly in excess of our selling prices and that you will make *substantial savings on every purchase.*

THIS new General Catalog for Fall and Winter is already in the hands of most of our customers. From this book they are learning a price message untold before in our time. More than this, its pages are unfolding a story of quality and value of which any store would be proud.

And now our great new catalog—The Thrift Book of a Nation—is ready for you. We think it so expresses the new day and the new standard of values and offers the new high quality merchandise at present in demand, that we would like you to have it.

From its 1100 pages, offering 48,000 articles, you may select everything you need in the quiet of your own home. Ordering by mail is most convenient. Try it once, if you would learn the truly modern way of shopping.

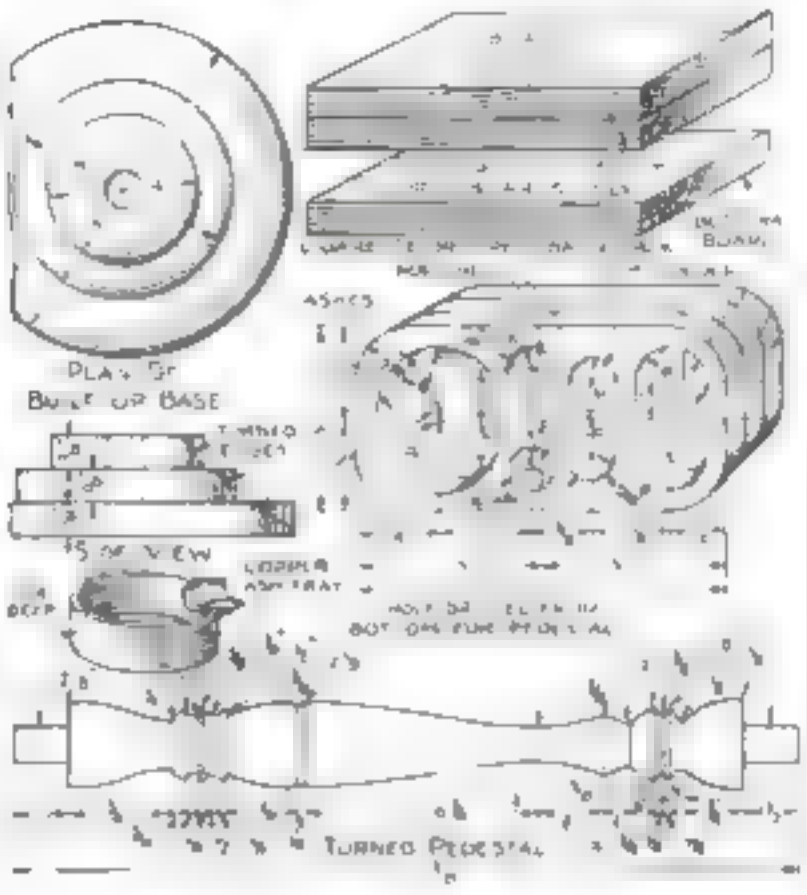
Ask for your copy of this book today. Just fill in and mail the coupon to our mail order store nearest you.

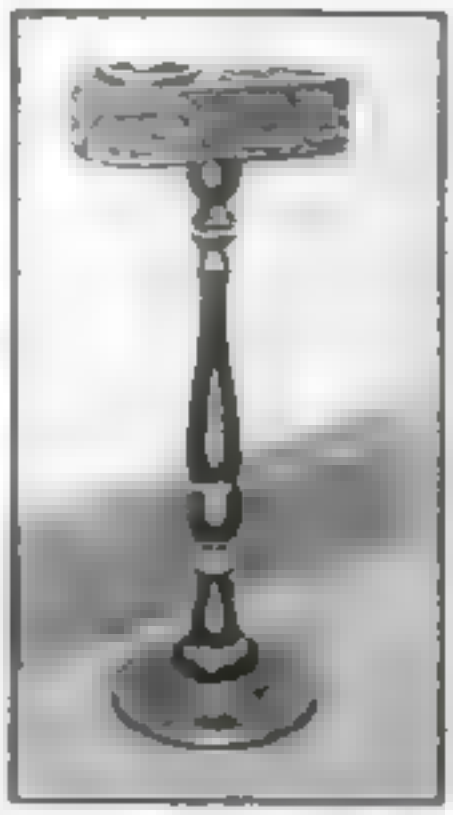
SEND TODAY

SEARS, ROEBUCK AND CO.
[illegible]
Mail Coupon to Store Nearest You
Send me your Latest General Catalog
Name
Postoffice State
Rural Route Box No.
Please give both Route and Box Number if on Rural Route
Street Address

Carved Stand *for* Smokers

By WILLIAM C. CLARK





The feature of this smoking stand is that the ash tray and matches are not obtained instead of money being laid on top as is usually the case

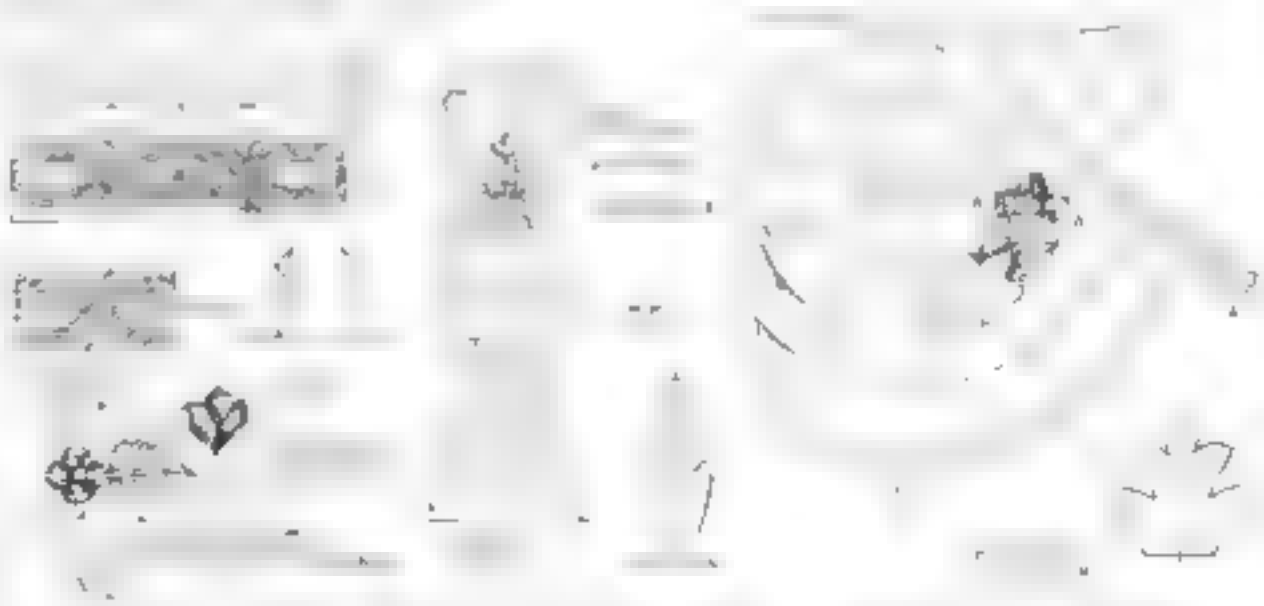
MOST members of the saw and hammer brigade have tried making a smoking stand. As a rule the woodworking part turns out well, but the ash tray and other commercial accessories used on the stand never look as if they really belonged. In the design illustrated however, the accessories are incorporated in the stand itself so that it becomes a complete, self-contained unit. The carved ornamentation is not necessary to produce a good looking piece of furniture, provided a high-grade cabinet wood is used and the finish is of the best.

True up the stock and glue together two boards 5/8 by 5 by 10 in. to form the upper part of the top. Lay out and bore the various openings, using an expansion bit for the larger holes. Complete shaping the recesses with gouge and chisel, and give the finishing touches with file and sandpaper. A third board of the same size is now glued to the first two. Round the corners as illustrated, and drill a 1-in. hole in the center of the underside to receive the tenon of the pedestal. Make an ash tray to fit the largest recess.

The pedestal and base can be turned on any small lathe. Perhaps you will prefer to follow a design of your own for these parts, but the over-all dimensions as given will make a stand of convenient height.

My stand, which is of black walnut, was given one coat of flat drying (rubbed effect) varnish without using any filler. Then the stand was rubbed lightly with steel wool and the uncarved portions polished with a coat of floor wax.

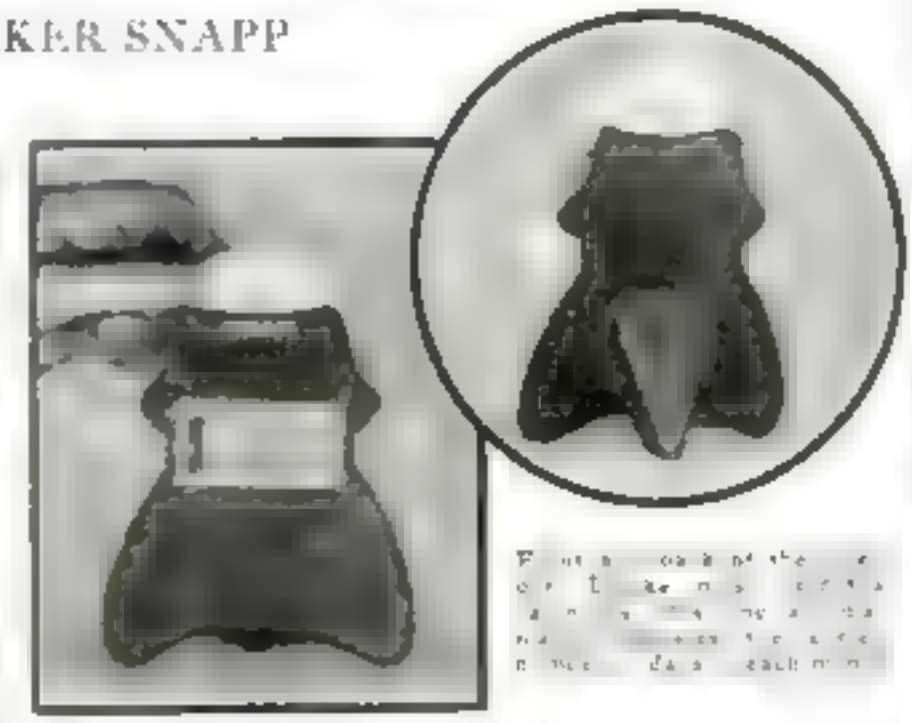
Mr. Clark has prepared some notes on carving the stand for those who wish to attempt this additional work. These have been incorporated in Home Workshop Bulletin No. 8, which will be sent to any reader upon receipt of a self-addressed and stamped envelope.



Details of the carving as sketched by Mr. Clark. Do not try to have all leaves alike; make every cut count; never use sandpaper or a scraper; and finish by rubbing with linseed oil

Ingenious Perpetual Calendar Formed from Cardboard

By PARKER SNAPP



THIS convenient little desk calendar, which can be made from cardboard, is "perpetual" in that its adjustable sliding cards need be renewed but once every two years.

The body of the calendar is built up of four layers, all cut to the shape of the half pattern shown in squares at the upper left of the accompanying drawing and then individually modified as shown by the dotted lines on the template and by the small silhouettes at the lower left.

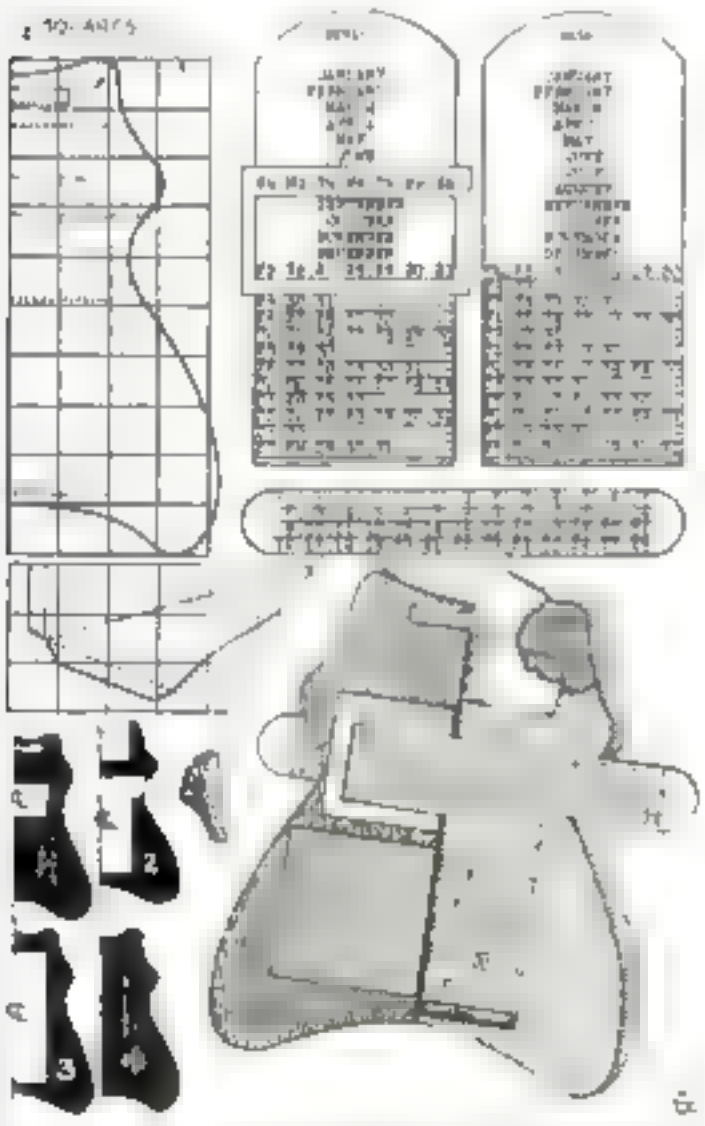
The first layer is made from a good grade of heavy cover paper—grained paper or imitation leather looks best—and in it are cut two windows. The lower and larger window is framed by a cut-out border upon which are typed the days of the week. Between the frame and the window, on the left-hand side, a narrow strip of red cellophane is glued to tint the Sunday numerals.

Layers two and three, of moderately heavy cardboard, are glued to the cover in succession. Layer four acts as a stiffener and is jig-sawed from the heavy back of a sketch-block or from thin cigar-box wood.

A small supporting leg is cut from the cover material as shown by the half pattern; then it is folded and glued to the back of the calendar. The sliding cards are typed on glazed cardboard or heavy drawing paper, and the two large vertically sliding cards are glued back to back. The cards and window border are given a coat of transparent shellac to protect the typing, and a rectangle of heavy blotter, 1¾ by 3 in., or a colored print is glued to the lower face of the calendar as a brushing touch.

HAT HOLDER FOR CLOSET DOOR

FOR apartment dwellers who are forbidden to make noticeable holes in doors and woodwork, the following method of hanging a large number of hats on a closet door should have a decided appeal. Two small screw eyes or hooks are inserted, one on each side of the door, so that a strong cord may be stretched between them. On this cord are strung about half a dozen spring type clothespins, the ends of which are covered with thin rubber tubing. These clothespins are used to hold the hats, which may be hung up or taken down in a jiffy. Additional rows of pins may be provided for any number of hats. This scheme has the advantage that no holes are made in the thin panels of the door.—W. C. R.



The holder is made in four layers, and the typewritten parts consist of a frame and three strips which slide.

A TOUCH fiber cloth moistened with gasoline will be found an excellent cleaner for motor and generator commutators. Hold the cloth around the revolving commutator shifting it back and forth occasionally.—L. B. R.

Tips on the Use of Reënforcing Steel for Concrete

By F. M. BENSON

MANY amateur builders who are working with reenforced concrete on small jobs, such as foundations for buildings, place the reenforcing steel haphazardly. But in this, as in all things, there is a right way which should be followed. The rules are few and simple, and when carried out will insure a strong and workmanlike job.

Reenforcing steel is usually placed latticelike with each intersection of two bars tied with wire. Number 14 wire is the most convenient to use for most work.

Fig. 1. How to carry a coil of wire and hold the pliers when laying reinforcing steel

One of the first things to learn is how to handle wire and pliers. The steel worker carries his wire with him in a coil over one shoulder and under the opposite arm (Fig. 1). The coil must not be too bulky or it will become tangled, and it should be small enough in diameter to fit fairly snug under the armpit so that it will not be in the way in close quarters.

The free end of the wire must come *down* over the shoulder, not up from under the arm. The reason for this is that when the wire is cut from a tie the free end tends to spring back to the coil and if it is pointing upwards, the worker is likely to be struck in the face.

Pliers should be 8-in. square-nose with good side cutters. Since they have to be used with one hand, they must not be stiff. The little finger is kept between the handles to open the pliers. This may seem awkward at first, but it soon becomes easy.

An important question is the kind of tie to use. The best is the one known as the "butterfly" or "figure eight" (E, Fig. 2), which is tied as in the four steps marked *A* to *D*. It is made by taking the

free end of the wire from the coil on the shoulder and looping it around the *back* bar of the two intersecting ones. Bring it around to the front, cross it over, and loop it around the back bar again. Make a half twist in front, cut the wire leading to the coil, and tie securely with the pliers, pulling out as you twist.

Before cutting the wire to the coil, bend it at right angles about 4 in. from the tie. This prevents the loose end from becoming lost in the coil and also makes it handier to start the next tie.

The "butterfly" tie has the advantages of preventing twisting or slipping from either direction. These are important because in high places the steel worker must use his completed work as a ladder as he goes up, and his own safety depends upon the strength of his ties.

The square tie (*F*, Fig. 2) is good, but is not as secure as the butterfly. The plain diagonal or loop tie *G*, which is so commonly seen, should never be used.

In placing reënforcing steel, care should be taken that it is at least 4 in. inside the concrete forms. On the other hand, it should not be buried too deeply in the concrete. The closer it can be kept to being 4 in. from the surface at all points, the better it is.

The openings of the latticework in a wall should be from 12 to 16 in., depending on the size of the form and the steel. In laying horizontal latticework near the floor of a large foundation or in a cement

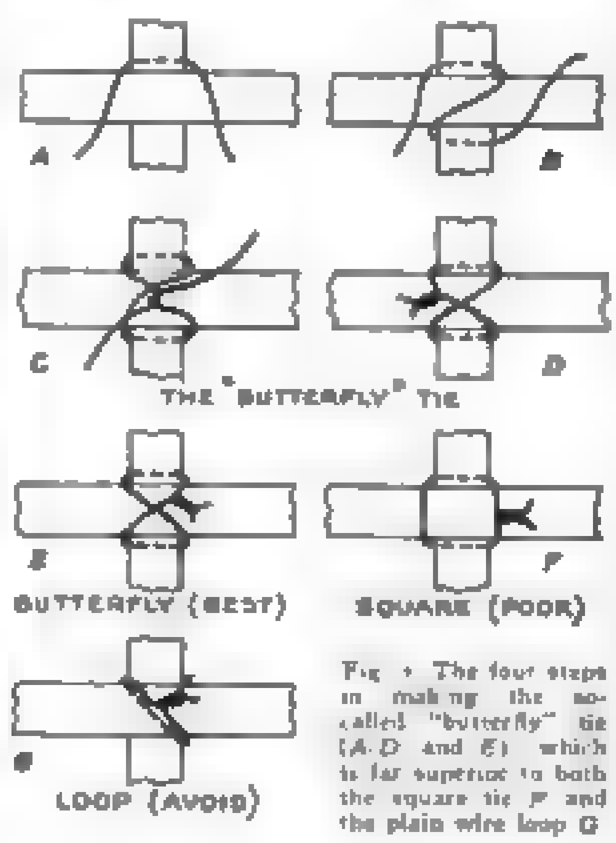


Fig. 2. The four steps in making the so-called "butterfly" tie (*A-D* and *E*), which is far superior to both the square tie *F* and the plain wire loop *G*

floor, the openings should be reduced to from 4 to 8 in. square. If the surface on which the concrete is to be poured is softer in some spots than in others, this bottom latticework may be called upon to bear a heavy strain.

In cutting reënforcing steel, which usually comes in bars 30 ft. long, a pair of strong bolt cutters are efficient for sizes up to ½ in. Above that size, the bars should be cut with an acetylene torch. A large number of bars can be laid side by side on supports, the desired lengths marked on them with soapstone, and then the whole cutting job be completed rapidly with a torch.

It is frequently possible, as in reënforce-

mg corners, to bend the rods instead of cutting them. When a large number are to be bent in the same shape, a bending table is convenient. On a strong platform made of 2-in. planks, outline the desired shape and drive a steel peg in at each corner of the pattern. The rods then can be laid on the table and bent to shape around the pegs.

For rods up to ⅝ in., a monkey wrench can be used to make neat corners around the pegs. For larger work, a stronger and lower balanced bending iron is necessary. This can be quickly made at the forge in the shape illustrated in Fig. 3, which shows a bending table in operation.

When it is desired to move a bundle of steel a short distance, raise one end and give it a flip as though it were a rope. The motion will be transferred to the end on the ground, and the bundle may be moved

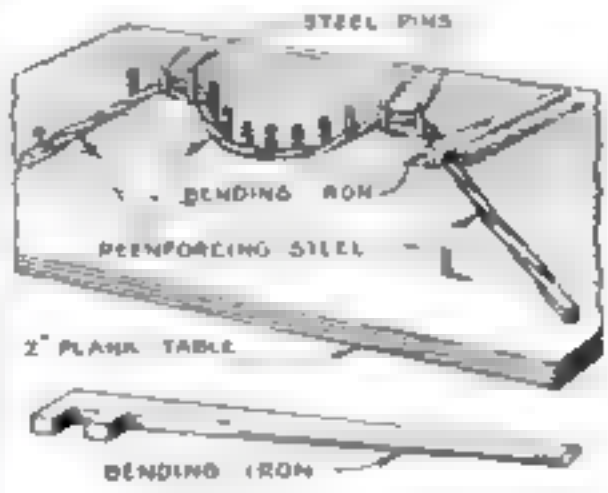


Fig. 3. Form for bending a number of reenforcing rods uniformly, and a special bending tool

with surprising ease. When carrying long steel bars, take short rapid steps, as the regularity of ordinary walking transmits a rhythm to the bar, and the spring of the ends is soon strong enough to throw the carrier off his feet.

On construction jobs where several days' work is necessary to fill a form, old scraps of reenforcing steel from 2 to 4 ft. in length are useful to bind one day's "pour" to the next. They are thrust for half their length into the fresh concrete and set at slight angles in various directions. The protruding ends are covered by the next day's pour and help to make a solid tie. Broken and worn out drill steel is also useful for this.

Although very little experience is necessary to become proficient in laying reenforcing steel, the difference in neatness and strength of the job when completed makes the effort well worth while.

TOOL FOR OIL GROOVES

WHEN cutting oil grooves in babbitt or brass bearings, the combination double-end boring and grooving tool illustrated will be found a timesaver. The pointed end of the tool is used for boring while the opposite end serves as a grooving tool.—W. S. GALLMAN

A double-end lathe tool which saves time in machining oil grooves in bearings

Electric Fittings That Simplify Wiring Jobs

By HAROLD P. STRAND

IN KEEPING his home shipshape, every man has to do a certain amount of electrical work. If he knows just what fittings to obtain for any given job he can save much time and effort. Some of the less familiar but very serviceable devices now available for household use will be described in this article and another to follow. These have been prepared because of the interest shown by readers in material of a similar nature previously published (see P. S. M., Mar. '30, p. 120, April '30, p. 118, May '30, p. 122, June '30, p. 107, and Mar. '31, p. 122.)

Is there a fuse plug made which contains more than one fuse and therefore will serve in spite of several blow-outs?

The six-in-one fuse plug shown in Fig. 1 has six fuse elements. In the case of a short circuit with the resultant blowing of a fuse, the only operation necessary is to turn the handle on the plug one notch, and a new fuse is immediately connected in the circuit. They are made in different ratings and fit in any screw type cutout block.

Can flush receptacles be obtained that are less conspicuous for particular installations than the common round-front type?

Yes, the newest receptacles will fit in a regular toggle switch plate opening and are used with that plate. With them very neat combinations are possible such as the one illustrated in Fig. 2, which is

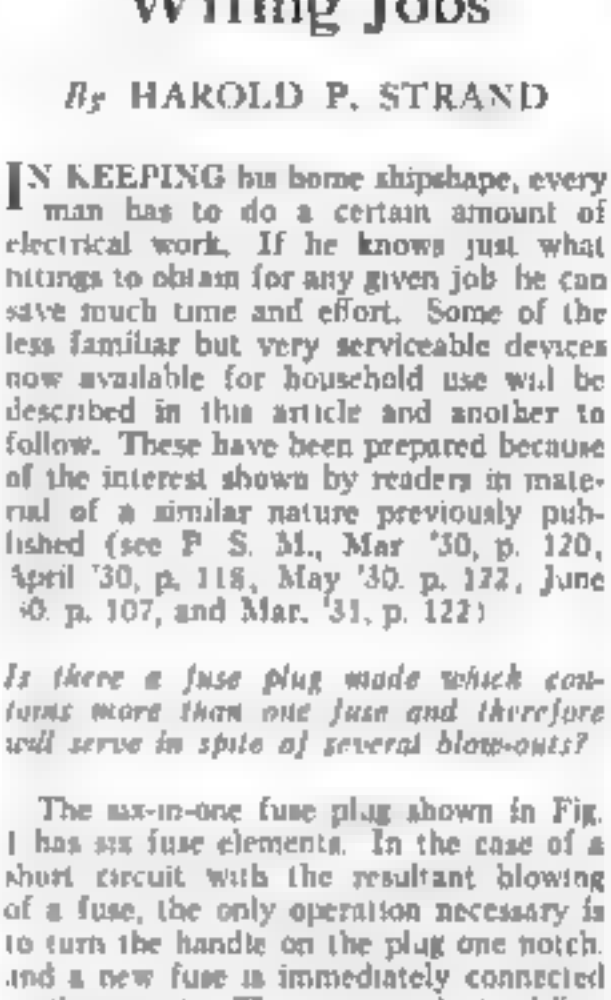


Fig. 1. This new multiple fuse does away with having to hunt for fuses in the dark

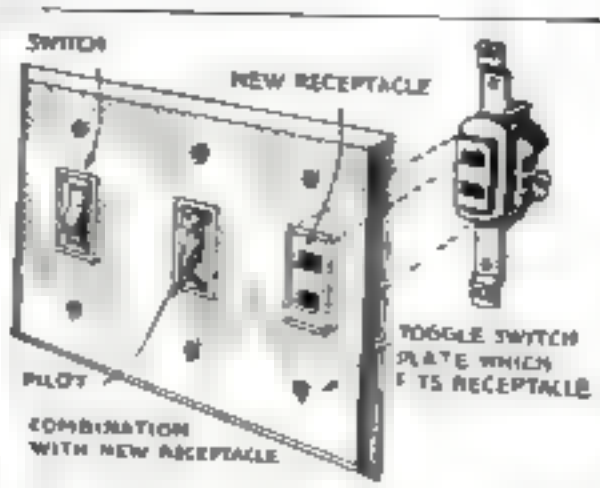


Fig. 2 Neat type of flush receptacle that fits into an ordinary toggle switch plate.

a switch, pilot and receptacle under one plate. All the openings are the same size and shape giving an attractive appearance. Standard cord plugs fit the new receptacles.

How can the nuisance of fuses be eliminated in submains—for example, in meter cabinets where fuses often cause a delay when they blow at a critical time?

Meter cabinets (Fig. 3) are now made with small circuit breakers to protect the circuits instead of fuses. When an overload or short circuit does occur the breaker is tripped to a neutral position, shutting off the service. To reset, it is only necessary to press the handle on the front of the cabinet to the "off" position, then quickly upwards to the "on" point. This saves the time required to hunt for the blown fuse and to obtain a suitable spare good fuse plug.

Fig. 3 A circuit breaker designed to replace fuses

Is there a method of hanging fixtures that allows them to be removed and changed to other locations without soldering and taping joints or other such work?

Fittings of the type shown in Fig. 4 are portable in a sense, yet strictly dependable and safe. The receptacle is attached to the outlet box, and the fixture has a two-prong

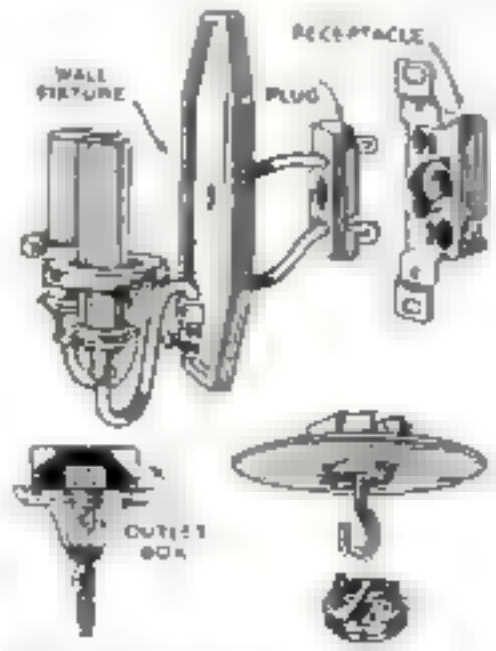


Fig. 4 Wall and ceiling fixtures which are easily moved from one receptacle to another

plug to suit. In the case of ceiling fixtures, the weight is carried by a hook that is a part of the receptacle, but the fixture canopy conceals these from view.

What is the easiest method of electrifying a bottle or a small-necked vase?

By the use of a ready-made assembly such as illustrated in Fig. 5. It has a corrugated rubber ring on the upperside which is pressed into the opening of the

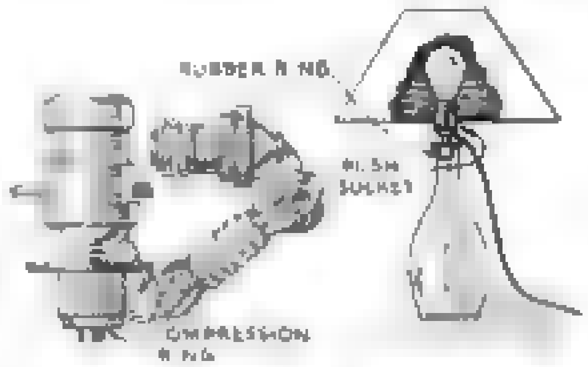


Fig. 5. A lamp socket which can be fastened securely in a bottle or a small necked vase.

vase, then by turning the socket to the right, a brass ring on the extreme bottom is brought up tightly against the rubber, compressing it until it fits firmly in the vase.

What is the most modern way to install a transformer for ringing doorbells?

A combination fitting now available in a bell transformer made integral with a steel cabinet that houses a cut-out block in which 3-ampere fuses are inserted (Fig. 6). This places the transformer in a safe mounting away from the woodwork and minimizes the danger of fire.

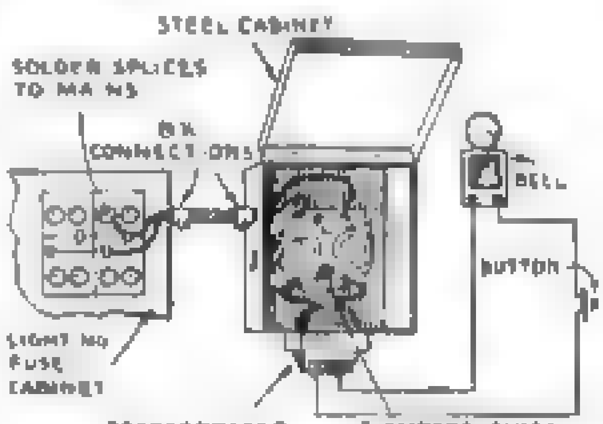


Fig. 6. Bell transformer built into a steel cabinet with a properly fused cut-out block.

MIXING COLORED DOPE FOR MODEL PLANES

ALL model builders now use colored dope for finishing their model airplanes, but it is expensive and sometimes difficult to obtain. Aniline dye of the desired color, however, can be bought at drug and paint stores. As an ounce colors about four gallons, only a few drams are needed. This is added to nitrate dope thinner or acetone, which can be bought in any drug store or model supply shop. An ounce bottle will hold all that is necessary of each color to keep on hand for ordinary use. A toothpick will be found useful in adding the dye to the thinner. In this way light and dark shades of the same color can be easily prepared to suit specific needs.—EDWIN T. HAMILTON

Unique *One-at-a-Time* *Cigarette* *Box*

By R. L. GRAVES

YOU HAVE seen many semiautomatic cigarette boxes in which the cigarettes are delivered singly in a trough but never a container exactly like the one illustrated. It has two unusual features. When the drawer or slide is opened, cigarettes from four separate compartments are brought into view simultaneously, so that your guests may choose the brand they prefer. Furthermore the action is positive. Every time the slide is pulled open, four cigarettes appear without fail. This is because the slanting floors of the hopperlike compartments are pivoted in such a way that the motion of the slide automatically shakes the cigarettes down toward the trough.

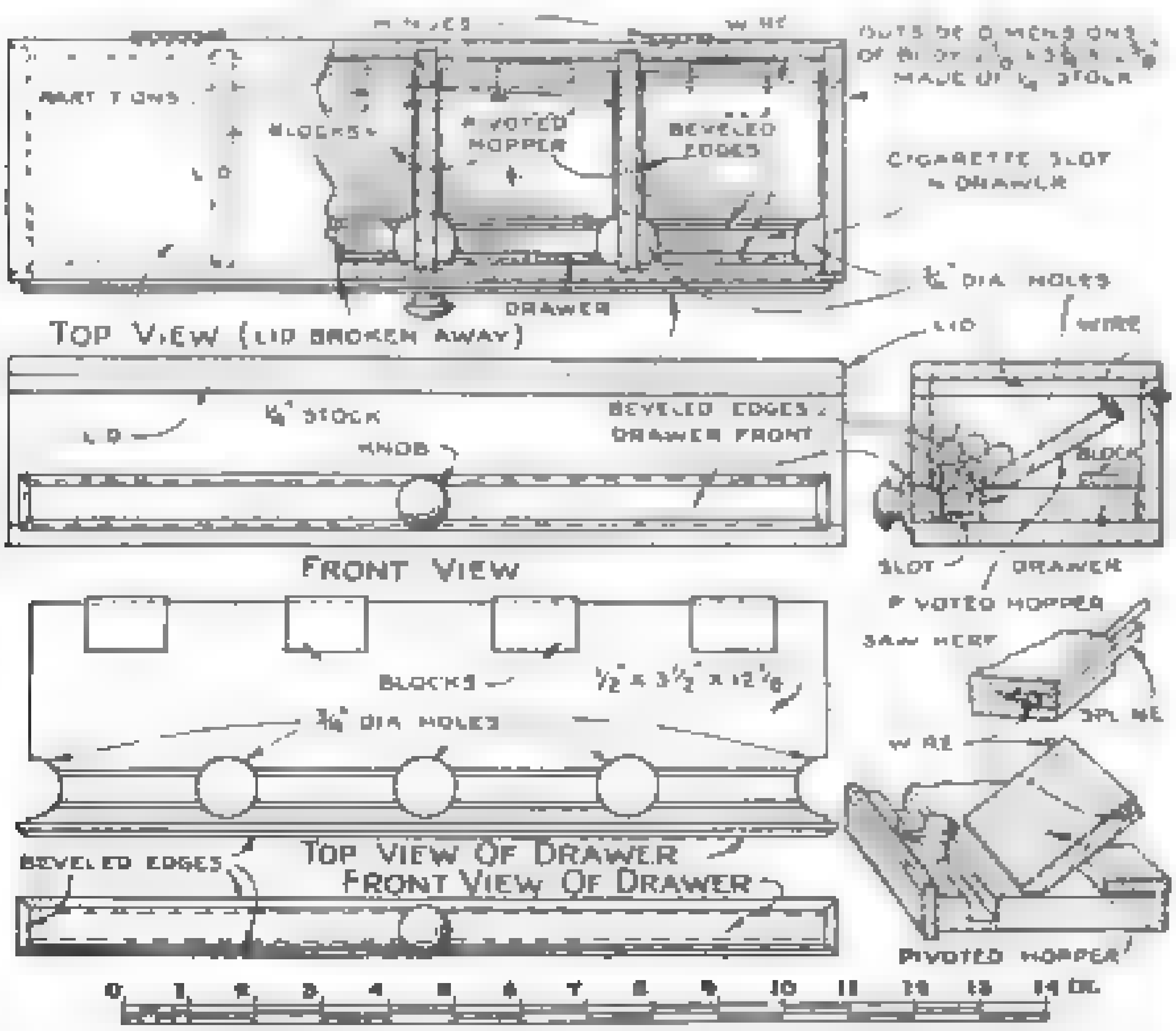
The construction of the box is very simple, and the materials need not cost more than twenty-five cents. I used 3/8-in. thick mahogany, which is one of the best woods for the purpose.

In making the front and the back of the box, saw three grooves to receive the partitions, and on the front piece saw out the drawer opening. When sides, ends, and tops are ready, slip the partitions into place and glue the box together. The top part is cut off later to form the lid.

A slot must be cut the length of the drawer or slide as shown, and it is desirable in addition to bore five 3/4-in. holes right through in the positions indicated to make it easier to get one's fingers in to lift out the cigarettes. At the back of the slide, four small blocks are added; each time the slide is opened these give the pivoted and slanting bottom pieces a jar to shake down the cigarettes so that they will fill the slot.

When the bottom is in place, saw off the top section of the box to form the lid and fasten it with two small hinges at the back. The four slanting floor pieces are then inserted in the four compartments and pivoted on a long, heavy wire going clear through the box.

Stain the wood a dark brown and apply



Top view of the cigarette box, partly in section, front view and sectional view, top and front views of the drawer or slide, and sketches of the pivoted floor of one of the hoppers.

● This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS — See page 8

When the drawer or slide is drawn out four brands of cigarettes are seen in the trough.

a coat of paste wood filler and two coats of varnish. Let each coat dry three or four days and rub the surface smooth with oil and pumice stone

If desired, the top may be inlaid carved, or ornamented with a transfer or a colored print

The box with the lid open showing the four hopper-like bins which hold the cigarettes

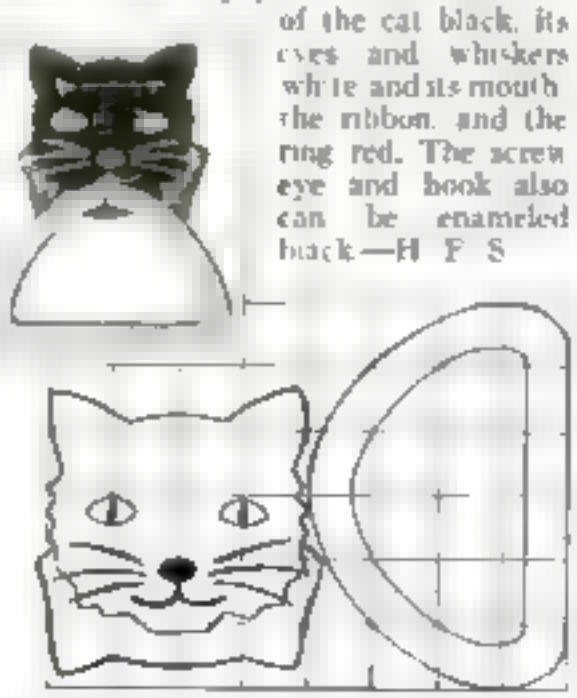
JIG-SAWED CAT'S HEAD SUPPORTS TIE RACK

THIS little rack is a pleasing novelty that has various uses. A man would hang his neckties on it, and a girl might use it to hold a gay scarf or some other bit of apparel

To make the pattern, draw a rectangle 6 by 8 in. and mark [illegible] squares then draw the lines of the patterns through the squares as shown and cut out the patterns. Trace around the cat's head on a piece of ½ in. thick wood and mark the ring on a thinner board of hard, tough wood or, better still, a scrap of plywood or pressed wood composition board

After sawing out the two pieces and smoothing them, put a screw eye in the top of the cat's head for a hanger and insert a suitable hook below the cat's chin to hold the ring

Transfer the markings of the cat's face from the pattern to the wooden shape with the aid of carbon paper. Enamel the head of the cat black, its eyes and whiskers white and its mouth the ribbon, and the ring red. The screw eye and hook also can be enameled black—H. F. S.



The completed rack and patterns of the two parts. Each of the squares represents 1 in.

CANNIBAL GERMS NOW WAR ON DISEASE

(Continued from page 191)

filterates, and made the visible bacteria change back to their invisible form by planting them in his high-protein medium. Dr Kendall believes it possible that all disease germs lead this kind of "double life," depending on what sort of diet they feed on.

The experimenter watched the germs as they changed from their visible to their invisible forms. They first lost sharpness of outline and grew blurred and fuzzy under the lens of the microscope. In the end, nothing remained but tiny granules, which passed through the fine filters. These little granules later became full-fledged, visible germs again either by growing or by reassembling themselves.

In the past, certain puzzling granules have been found in the spinal fluid of patients in the early stages of certain diseases. These, it now appears, may be the half-changed germs in the process of becoming invisible. For use in future experiments, Dr Kendall has perfected a new, refined form of his "K medium" prepared from highly purified, crystalline proteins.

WHILE Kendall's findings, according to expert medical opinion, probably will work radical changes in the future treatment of a number of diseases, the earlier discovery of bacteriophage already has had a far-reaching effect on medical practice. It has freed medical men from the helplessness with which they formerly approached infections. In the light of Kendall's discoveries, there remains little doubt that these tiny cannibals, so destructive to their brothers but harmless so far as man is concerned, will prove the physician's most powerful allies.

In Senegal, French West Africa, phage was given a trial recently against bubonic plague. It was at first administered to patients in advanced stages of this terrible disease. Among these sufferers, we are told, the mortality, by any other methods of treatment, would have been one hundred percent. Yet when bacteriophage was brought into the field, the number of cures effected were in the proportion of fifteen to twenty-nine.

Under the direction of the Oswaldo Cruz Institute of the Brazilian government during the last few years, 10,000 cases of dysentery have been treated by bacteriophagy. Out of all these only two failures have been reported.

BACTERIOPHAGY was tried for the first time in a cholera epidemic in the Punjab, India, not long ago, with striking success. Under all previous methods of treating this Asiatic scourge, the mortality ran from sixty to eighty percent. But when phage was tried, fatalities dropped to as low as eight and one-tenth percent!

The discovery of bacteriophage has solved the ancient riddle of the Ganges River in India. By the Brahman temples at Benares thousands of natives bathe daily in the sacred stream. Yet a few miles upstream from their bathing *ghats* at the temple steps the river is unbelievably filthy, since it receives the drainage from a densely populated land that for centuries has known no sewage system but the sluggish streams and rivers.

It would be almost certain death to bathe in many parts of the Ganges. Still, for hundreds of years, millions of natives have washed in it, protected from infection as we now know, not by their own strange gods but by bacteriophage that devour the disease germs.

Let us watch the phage at work. Since we can't see it by any scientific means, let's suppose ourselves *(Continued on page 230.*

A definite program for getting ahead financially will be found on page four of this issue.

CANNIBAL GERMS NOW WAR ON DISEASE

(Continued from page 126)

equipped with eyes far stronger than the most powerful microscopes, eyes to which a grain of dust seems as large as a baseball. Now let us watch carefully while the phage attacks, say, a *staphylococcus* germ, the kind that makes all the trouble in infected wounds, carbuncles, and boils. This germ, resembling a bunch of grapes, consists of a number of globular germ cells nestled together. The cluster, though, is infinitely smaller than a bunch of grapes; in fact, a grain of dust might be covered with hundreds of them.

Alongside one of these germ globes, the phage, if we could see it, would probably look about as big as a torpedo alongside a battleship, and it is almost as deadly. With our magnified eyesight we see the phage attach itself to a germ and disappear within it. Once inside it begins to eat, making more room within its host. This added space it immediately fills with its offspring, for as the phage eats it multiplies, and it keeps on eating and multiplying, until there is nothing left of the germ but a hollow shell filled with phage corpuscles. Then the germ's shell bursts, liberating thousands of new phage, all ready to carry on their life work against the enemies of man.

THE eating process which you have just watched is not a tearing with teeth and jaws. It is rather an "eating" like that done by some acids when they are brought into contact with certain materials.

Now let us go into a laboratory and see how this powerful new weapon against disease ordinarily is handled by medical men. New methods probably will be developed as a result of Dr Kendall's work. We see a man partly fill each one of a number of test tubes with an amber colored fluid. Holding his tubes up against the light he shows us that the liquid is transparent, explaining as he does so that it is a culture medium, a broth made of animal hearts. Into each tube, or culture, he puts samples of bacteria taken from a patient on whom bacteriophagy is to be practiced. Then he closes the cultures, telling us that he must let them stand for several hours.

When we return to the laboratory, we find the bacteriologist holding his cultures up to the light, one by one. We see that the culture medium, formerly transparent, is now opaque. In reply to our question, he says:

"When the medium gets cloudy like this, it shows that the germs are active and breeding. We know that they are all thriving and healthy and have settled down to live in their new surroundings."

As we watch him he places several drops of a clear colorless fluid into each culture, taking the new liquid from as many different containers as there are cultures. "This is the phage," he informs us. "We aren't sure yet just which phage will kill germs of the disease on which we're working. So we raised several germ families and now we're going to try a different phage on each of them. In that way we'll know what phage will kill them."

ON OUR next visit, the bacteriologist chuckles as he hands us one culture out of the row on which he has been working. This one, instead of being opaque like the rest, has returned to its former transparent state.

"This is the phage," he tells us, "that will do the trick. When a healthy culture turns transparent, it shows that the germs in it are dead. So this is the phage we'll give our patient, but first we must do some further checking up on it."

Several drops of the sterilized culture are put into each of the other test tubes that contain still active germs. After standing for several hours it is noticed that these also have become sterile. After this the cultures are strained through a Berkefeld filter. This is an odd-looking glass bottle with a narrow neck, into which is fixed a porcelain "candle." The cultures are strained through this into a tube in the bottle.

It is explained that this filtering is a precaution, taken to remove any germ that may have escaped the phage.

A PLAGUE of locusts near Sauterelles, Mexico, in 1909 led to the discovery of bacteriophage. All human methods failed to check the ravenous horde of buzzing insects that were wasting the countryside. At last nature, having sent the dreaded visitation, began herself to destroy it.

People noticed that the insects were beginning to fall dead in great numbers. Evidently some strange disease had killed them, but what was it? Scientists went to work on the dead insects, dissecting and examining them.

Taking samples of the bacteria found in the bodies of the locusts, they bred them in laboratory cultures for study and experiment. Cultures of the disease which had killed the Sauterelles locusts were sent to other regions afflicted with the locust pest. A few of these locusts were caught alive, and into them were injected germs of the new disease. Then the captives were liberated, to fly away and rejoin their comrades.

Soon the Sauterelles conditions repeated themselves. The foreign locusts began to die in great numbers and the plague was shortly a thing of the past.

Not long after this discovery, research work in connection with it took a new turn. If a parasite could be found that would destroy germs of disease in locusts, why couldn't one be found that would do the same thing for man's illnesses? It was this question that d'Herelle finally answered in 1917. The medical world was not slow in realizing the importance of his discovery. Test tubes and microscopes were unlimbered on a world wide front as a new drive against infection and disease began.

Almost from the first the drive has taken the shape of a hunt for new and different phage. Since the first ones were discovered in bacteria taken from the digestive tracts of sick locusts, it was apparent that the amazing little parasite bred in filth. So highly-fertilized ground, sewers, and polluted streams like the Ganges became the hunting grounds for the new and friendly little organism. The sewers of Paris, incidentally, have been found to supply the best strains of phage found so far. Work of this sort, however, may be superseded by Dr. Kendall's new discoveries.

THE method of extracting these invisible growths from their natural surroundings is similar to the application of them to the cure of human diseases. Samples of sewage are drawn up and strained successively through different filters. The last step in this process is a porcelain candle, from which the sewage sample emerges as a clear colorless fluid. A few drops of this are then put into a germ culture, which is then carefully watched. If it does not become sterile, bacteriologists know they are on the wrong track—there are no phage in the sewage sample they just tried.

When a germ culture finally becomes sterile as the result of application of filtrate from sewage samples, an almost unlimited supply of phage is at hand.

MY 10,000 FLIGHTS IN UNTRIED AIRPLANES

Continued from page 7

near London. At that time, the greatest test pilot in England in my opinion was Fred Raynham. His narrow escapes would fill a book. One of them gave me the first rule I always observe in the testing of all new machines.

Raynham was up in a twin-engined Avro bomber at Brooklands, in the spring of 1914. High in the air, he closed the throttles to glide down for a landing. Instantly the tail dropped, the nose reared skyward. He slapped on the engines again, just in time to prevent a stall. Half a dozen times, the same thing happened. The ship hadn't been weighed for balance and had taken off tail heavy. When the engines were wide open, the gale from the propeller gave sufficient lift to the elevators to hold the craft level. But as soon as the blades slowed down, the tail of the plane sank.

In this particular machine, the pilot sat far at the nose of the fuselage, the observer back behind the wings. The two tractor propellers were set close together, their glittering circles almost touching the narrow top of the dragon-fly body. Later measurements showed that these deadly disks whirled so close together that less than three inches clearance on either side would be given a man crawling along the fuselage top. And the tip of a spinning propeller will shear through the body of a man as cleanly as a razor cuts a cotton thread.

THE observer, watching from the rear cockpit, realized this. He also understood why Raynham couldn't go down. Pulling himself out of his cockpit, this unsung hero of the air clung hatless to the upper surface of the fuselage while the big ship rushed at top speed through the sky. An inch at a time, he dragged himself toward the tiny "tunnel" between those whirling knives. Flattened to the canvas, he edged between, praying the rocking ship wouldn't lurch in a gust or down current. When he dropped into the forward cockpit beside Raynham, his weight balanced the plane and permitted a landing.

Raynham described to me his feelings at the time and ever since. I have never hopped off for a test flight without weighing a ship to be sure it is properly balanced.

This is comparatively easy. The two landing wheels and the tail skid are placed on scales. The readings of these instruments, taking into account their distance from the center of lift of the main wings, on which the plane is balanced like a seesaw while in flight, shows whether the ship is properly balanced. Once, I weighed up a very light pursuit plane in this way. A mistake had been made in construction and it was 100 pounds tail-heavy. If I had taken the plane into the air, I would have been piloting flying dynamite.

Besides weighing up a new ship, I observe a number of other rules. First, I climb into the cockpit and make sure the controls are working properly.

NOT long ago a $70,000 plane was wrecked at a Long Island field because the pilot failed to "waggle" his stick before the test flight. Had he done so he would have found that the ailerons had been hooked up backward. In another case, a huge air-liner was washed out in New Jersey on its first test flight. A careless mechanic had attached the elevator control wires in reverse and the pilot hadn't noticed it until he tried to take off.

Another thing I do is adjust the controls until there is no friction or play. Not one plane in a hundred has the controls in perfect adjustment. When I recently made tests of the huge Curtiss "Condor" at St. Louis, Mo., I altered the rudder several times by a method I devised and have used for several years. To save expense, I rigged up a plywood box which I bolted to the rudder in different positions, one time adding area to the balancing surface ahead of the point where the rudder was pivoted, and again to the rudder itself.

Each time I would hop off and fly the plane, noting how it steered. When I found the best adjustment, a new control surface having the same ratio of balance area and rudder area was constructed. This saved the expense of building a whole series of new rudders in order to discover which would give the best results.

BEFORE I even start the engines on a testing job, I may spend hours sitting in the cockpit. I go over the instruments, get familiar with my surroundings, practice just what I will do in every emergency I may meet in the air. I cut the switch and shut off the gasoline a hundred times, until the movements become subconscious. Such practice has paid for itself a dozen times over.

For instance, not long after the war, I took off on a test flight from a small English field in a de Havilland bomber with twin Liberty engines. At the right of the pilot's seat, five fuel pipe lines met, with stopcocks that let the pilot regulate the fuel flow.

Four hundred feet in the air just over the edge of the field, one of these stopcocks broke off. A one-inch jet of high-test gasoline shot from the end of the broken pipe. In an instant, the floor of the cockpit swirled with explosive fuel. The slightest spark would have made the ship a soaring furnace.

Choking in the fumes and half blinded by spray on my goggles, I instinctively found the switch and cut the roaring engines. I had just sufficient height to swing in a half-circle, push the landing wheels through the bordering hedge, and sit down in the field. Twenty feet less height would have spelled a certain crash.

That narrow squeak emphasizes another rule I since have followed: Have a big field for a test flight. Then if the unexpected happens, there is plenty of room in which to maneuver.

One ship I tested turned into a mechanical broncho bucking in the air. If I had not had a big field to land in, I would have washed it out in getting down. The elevator flaps had balancing areas which extended ahead of the point where the elevator pivoted. Their purpose was to make the controls easy to operate. In this plane too much area had been allowed for this purpose.

AS LONG as the engine raced at full throttle, the slipstream from the propeller, which passed over the elevator surface but not over the balancing tips, gave the elevator more power per square foot than the balancing tips. But as soon as I throttled down at the top of my climb, the stick jerked out of my hand. The balancing surfaces, out of proportion, rocked the elevator up and down. The ship reared and plunged in the sky. I shoved open the throttle. The plane flew smoothly again. I was bewildered. The only thing I could do was to land with the motor on and trust to luck when I cut it.

Only three or four inches up, I skimmed the field going 120 (Continued on page 13)

MY 10,000 FLIGHTS IN UNTRIED AIRPLANES

(Continued from page 131)

miles an hour. Then I cut the gun. The plane bounced all over the field. A tire blew out. The ship slewed into a ground loop and stopped in a cloud of dust, only slightly damaged. Only a big field made a landing like that possible.

The longest time I ever spent on a test job was on a large triplane bomber in which two 500-horsepower motors, housed in an engine room in the cabin, drove four propellers out on the wings through gears. Running these gears in the flexible structure of an airplane was a very different thing from running them in the engineering shop, and gear trouble was always cropping up. It was two and a half years before tests were completed.

The shortest time I ever spent on a test job was in trying out the world's ugliest plane. It was named "The Ape." A high grasshopperlike landing gear permitted rough landings and variable wings and tail allowed a thousand and one experiments to be made with the queer "flying laboratory," which was designed for researches by the Royal Flying Corps. All I was required to do was to get it off the ground.

BUT probably the queerest machine I ever tested was a strange "cube lift" biplane. A rich enthusiast designed it to revolutionize flying. As engineers know, there is a limit to the size of big planes. As they grow larger, the wing surface advances as a square while the increased weight advances as a cube. So the ratio of weight to wing surface is increasingly greater the larger the plane is built. On the other hand, dirigibles advance in lifting volume as a cube and in head resistance as a square, so they become more efficient as they grow in size.

This designer maintained he had found a way to build large wings so their increase in lifting power kept pace with their increase in weight. All he had done was decrease weight by leaving out bracing struts and building his wing tips perilously thin. In the air, these tips flapped and fluttered, ready to fold up in the first hard gust. When I flew the plane, I heaved a sigh of relief when I got down alive.

Fortunately, before I made that flight I waited for a perfectly calm day. That is another of my rules that has paid rich dividends. I never go up on a first flight in a strange ship in gusty weather. Only once have I broken this rule. That was in an emergency in 1919 and afterward I wished I hadn't.

A big twin-motored distance plane had been built for me to fly the Atlantic nonstop in a race with Harry Hawker and Capt. John Alcock, the first man to achieve the honor in a heavier-than-air machine. Both their planes were already in Newfoundland when my machine was finished. Time was precious. A mean cross-wind was blowing at the Norwich field, but we decided to go ahead with the tests. I had just left the ground when the upwind motor cut out. The other engine, combined with the wind, pulled the ship around before I could jerk back the throttle. There was no time to straighten out. The plane crashed, wiping out the landing gear, wrecking the lower wing, and destroying my chances of being the first airplane pilot to bridge the Atlantic in a single hop.

SOMETIMES testing a new fitting is more dangerous than trying out a whole new plane. I remember once an inventor hired me to test an "air brake" to slow down a plane quickly on landing. It was a flap that popped above the main wing like a jack-in-the-box when I pulled a lever in the cockpit. The sudden added resistance slowed down the plane close to the danger point.

The idea sounded all right, but I was skeptical. I climbed to 10,000 feet before I pulled the release lever. In a flash I was hurled forward against the double safety strap I always wear in testing planes. The ship dropped like a stone. I have no idea how far we fell before I found the lever and pulled the flap inside. It had worked too well. As you know, the upper surface of a wing contributes two thirds of the lift and the under surface one third. This is the result of air currents forming a partial vacuum above by the wing curve. The flap had disturbed these lifting currents as well as formed sudden added resistance. If it had popped out near the ground in landing, the ship would have dropped like a lead pancake.

The effect of this flap was exactly opposite that of the Handley-Page wing-slots which I tested early in 1922. These narrow auxiliary wings in front of the main supporting surfaces keep the air currents going steadily over the top of the wings even at low speeds. This prevents the pilot from losing control and going into a tail spin that may end in a crash.

AS I look back on my fifteen years of test flying I think one of the biggest scares in all my experience was over something that never happened.

I was testing the "Awana," a giant troopship, after the war. This folding-winged monster could carry more than twenty soldiers at a load. On the test flight, we placed 120-pound bars of lead in the cabin to represent the men, and one bar in the pilot's compartment to take the place of the navigator. On the last test, a speed run, the chief engineer went along. With the throttles wide open we roared down the field 200 feet above the ground. Going two miles a minute, we heard a terrific crash behind us. We thought the main wing spar had broken. I cut everything. Each breath, I expected the wings to crumple and hurl us to the ground. We were in a cold sweat when the wheels touched and we were safe. The instant the plane stopped rolling, we piled out, going over the wings, fuselage, and tail. Nothing was wrong.

We were on the point of ordering the pulling apart of the wings so we could look inside, meaning a loss of thousands of dollars, when we stumbled on the secret of the sound. The bar in the cockpit had broken free and during the speed trial the vibration from the thundering engines worked it back along the floor. Between the cockpit and the cabin there was a five-inch step. As we raced at full speed, the 120-pound bar had made the drop to the wooden floor below, the sound reverberating in the cabin like the crash of a giant timber and naturally giving us a fine scare.

A TEST pilot, who risks his life in untried planes, must be prepared for anything. The surprise may be a false alarm or a desperate crisis. In the world of flying men, he plays a role replete with thrills and drama, which he has to treat as ordinary mechanical happenings. He is using the sky for his laboratory in work that plays its part in bringing better planes.

MORE fine articles on the way from this great flying man. Watch for them in early issues of POPULAR SCIENCE MONTHLY. —THE EDITOR

CONCEIT MAKES GOOD DRIVERS BAD

(Continued from page 74)

rights as you have. It isn't a question of brains. A dim-wit who can't read or understand anything beyond a tabloid newspaper may be a better and safer driver than a mechanical genius with a whole head full of gray matter. The dim-wit may not know much but if he has the right idea about what he does know, I'll drive with him any day.

"Of course conceit is only one of the three main causes of accidents. Carelessness comes first, swelled headedness next and third place goes to those unfortunate people with nerves and muscles that never learned how to work together—people who turn the wheel the wrong way or step on the accelerator instead of the brake when they get into a jam. The fancy name for that is lack of muscular coördination, but it really is an extra severe case of plain clumsiness just as swell-headedness is too much development of the ordinary pride everyone should have."

"Seems to me Meekins is in that class," Joe again interrupted. "He's clumsy."

"HE'S clumsy only because he hasn't driven very long," Gus replied. "There's nothing the matter with his muscles and nerves, they just need training. The fellows I mean are so clumsy they won't ever learn no matter how long they try. In factories where they have a lot of machinery they call the hopelessly clumsy or conceited workmen repeaters because they keep on having one accident after another as long as they are on the job.

"Meekins already has got to the point where his foot slams on the brake without his having to think about it—I watched him the other day when he was driving out and a car came around the corner unexpectedly. And he seems to get out of his way to give the other fellow a break. Some day he may have a smash, but if he does it'll either be the other fellow's fault or else it'll be one of those unavoidable freaks that do happen once in a while where nobody's to blame."

"Well," said Joe as he pulled out his ledger and prepared to make out the monthly bills, "it all sounds fine the way you say it, but I think you're getting a bit too theoretical like some of those psychology sharps with their subconscious reactions and all the rest of that patter."

JOE'S voice trailed off into a grunt of displeasure as he became absorbed in an account that was several months overdue.

Some weeks later, Joe arrived at the Model Garage at opening time with a sheepish expression on his face. He thrust a copy of the local paper under Gus's nose. "I guess you win," he muttered.

Gus took the paper and began to read the following item:

Hurt in Car Crash

A car owned and driven by H. D. Grandin, 342 West Main Street, was wrecked and Grandin sustained a fractured leg in a collision with a truck driven by John Giltry, at the Hillsbury crossing on the turnpike yesterday afternoon. Giltry was uninjured and his truck was but slightly damaged. Grandin was rushed to the hospital where it was said his injuries were not serious but will keep him confined for three weeks or a month. Grandin blames Giltry for the accident, saying that, as he came to the crossing, he blew his horn in time for the truck to get out of the way. Giltry asks: "Why didn't Grandin stop?" Turnpike police have started an investigation.

HOW MAN-APES BECAME MEN

Continued from page 24

south of the nearest home of any known living ape. This would be remarkable enough in itself, but there is more. It is a region which is arid now and has been for long geological periods—a million years or more.

MR. MOK: What is so striking about that?

DR. GREGORY: The striking part is that it is in just such a situation, far away from any forest, that scientists look for the birthplace of humanity.

MR. MOK: Why?

DR. GREGORY: Because many authorities believe that, if the forest had remained intact, there would have been no incentive for our apelike ancestors to come out on the plains, and you and I would still be living in the trees. But no matter where humanity arose, I feel confident that it was this kind of creature that heralded the advent of man.

MR. MOK: Where do you believe this great event occurred?

DR. GREGORY: There are hosts of things I am not sure of, but of one thing I am absolutely certain. That is that man originated in the Old World, I mean in the Eastern Hemisphere, but not in Australia. There are two historic schools of opinion as to where in this wide region it may have happened. Darwin hinted that man might have emerged from the apes in Africa, but all other scientists, with few exceptions, look to Central Asia as man's most likely birthplace. As you know, the expedition of the American Museum of Natural History, now exploring Mongolia under the leadership of Roy Chapman Andrews, is constantly searching that country for clues of man's origin. Dr. Dart is one of the exceptions. He believes his little man-ape shows that Africa must have been the cradle of humanity.

MR. MOK: How long ago did the African man-ape live?

DR. GREGORY: In any case, more than a million years ago, perhaps five or six million years.

MR. MOK: Then the Java Man is more recent?

DR. GREGORY: Very probably.

MR. MOK: You told me there were several of these fossil men, all about the same age. What are some of the others?

DR. GREGORY: One of the most famous is the Piltdown Man, so called because he was found, about twenty years ago, on Piltdown Common, at Fletching, in Sussex, England. When I say "he," you must realize that all that was found at first was a number of skull fragments. A workman, digging in a gravel deposit, smashed the skull with his pickax, scattering pieces over the road. The fragments were gathered up by an English geologist, Charles Dawson, and taken to the British Museum. Immediately, another big scientific fight flared up.

MR. MOK: What was the trouble this time?

DR. GREGORY: The skull was restored, meaning that scientists, after careful measurements and calculations, reconstructed the head, much in the same way in which you can reconstruct a circle from one or more segments of the circumference. This was done independently by several experts. The results ranged all the way from the moron to the intellectual!

MR. MOK: How did each man picture the old citizen?

DR. GREGORY: Sir Arthur Smith Woodward, foremost English fossil expert, put the pieces together in such a way as to produce a very small brain-case, almost apelike in its restriction. Sir Arthur Keith, the eminent British scientist, went to the other extreme. His restoration showed a baboonlike head as large as that of many modern men. For a time, scientists, taking sides with either of these men, were at daggers' points. Then Professor Elliot Smith, of the University of London, and Professor J. H. McGregor, of Columbia University, New York, made restorations that struck a happy medium between the two. McGregor's reconstruction has been adopted officially by the American Museum. It gives the Piltdown Man a somewhat higher type of skull than that of the Java Man.

MR. MOK: Did that satisfy everybody?

DR. GREGORY: Pretty well. Meanwhile, a yard from the exact spot where one of the skull fragments had been picked up, part of the lower jaw was found, with two molar teeth in place. Still, all was fairly peaceful. But a couple of years later, the Rev. Teilhard de Chardin, a Jesuit priest, one of the world's greatest authorities on fossil men and mammals, found a single, long, apelike canine tooth in the same gravel deposit. This started the battle afresh.

MR. MOK: What caused the new disagreement?

DR. GREGORY: The canine tooth obviously belonged in the jaw, which was very apelike. Here, then, was a creature with a human skull, though primitive, and an apelike jaw and tooth, while the Java Man apparently shows these features more in reverse. As I told you, the *Pithecanthropus* skull outwardly is so apelike that many at first dismissed him as a gibbon. The contrast between the Piltdown skull on the one hand and the jaw and teeth on the other was so striking that Dr. Gerrit S. Miller, distinguished American authority on mammals, flatly declared that what we were dealing with were the remains of a primitive man and those of an extinct species of chimpanzeelike ape. As a matter of fact, the question isn't really settled yet, though the majority now agree that the Piltdown Man was actually one creature—a man with apelike jaws and teeth.

MR. MOK: Are the apelike teeth of the Piltdown Man another example of what you call "booby traps for scientists?"

DR. GREGORY: This certainly looked like one, and Dr. Miller still thinks it was. But I will tell you of a much more striking instance. Have you ever heard of the million-dollar pig-tooth mystery?

MR. MOK: I have not.

DR. GREGORY: That is the worst booby trap case on record. I ought to know, for I was one of those caught in it. Some years ago, a Nebraska archeologist found a half-inch, badly worn down fossil molar tooth in a rock deposit which placed its age at several million years. Delighted with his find, he sent it on to Professor Henry Fairfield Osborn, president of the American Museum, who handed it over for study to his scientific assistants. After much research, all of them agreed that it was the tooth of a very ancient primitive man or of a manlike ape. Professor Osborn thereupon christened it *Hesperopithecus*, meaning the ape of the western world. But there were a number of scientists, both in this country and in England, who, when they got a look at the molar, didn't at all agree with this conclusion. That started the excitement.

MR. MOK: What was their opinion?

DR. GREGORY: (Continued on page 135)

HOW MAN-APES BECAME MEN

(Continued from page 134)

There were about as many opinions as there were experts. The poor little tooth was ascribed to a zoötul of animals. One thought it belonged to a bear, a second said it was the milk tooth of a fossil horse, a third believed it was the middle-ear bone of an extinct giant mammal, and so on. In preparation for a response to these criticisms, Professor Osborn turned the tooth over, for further study, to some of his associates in the Museum, including myself.

MR. MOK: What did you do with it?

DR. GREGORY: We worked on the thing for months. We compared it with the teeth of every known animal. We had X-ray photographs made of it from every angle, and also of the teeth we compared it with. Then we published two scientific papers, in which we completely endorsed Professor Osborn's view—that is, we decided it was the tooth of a high form of apelike creature, though we were not sure whether of an ape or of a man. Still, the criticisms continued.

MR. MOK: What was the next step?

DR. GREGORY. The next step was a jump! I personally went to Nebraska, where I joined an expedition sent out by the Museum to gather corroborative material. We sifted tons upon tons of sand and fossil fragments, and found about a dozen similar teeth, some of which had the crowns preserved, which our specimen had not.

MR. MOK: Did that settle it?

DR. GREGORY: Indeed, it did. To our horror we discovered in this way that our "treasure" was a molar of a fossil species of peccary, a remote relative of the ancient pig!

MR. MOK: But why did you call it the "million-dollar" pig-tooth?

DR. GREGORY. When the X-ray photographs were about to be taken, I handed the tooth to the operator and jokingly told him: "Please be very careful with this—it is worth a million dollars." The poor fellow took me seriously and got so nervous that he promptly dropped it on the stone floor. It broke into a thousand tiny pieces, and a colleague of mine and I had a fine time picking up the pieces and putting them together again. Later on, I published a paper correcting our *Hesperopithecus* error, but still I often was reminded, sometimes far from gently, of the "value" I had placed on the tooth. Thus ended ignominiously the one hundred percent American ape. But science profits from its mistakes, for had this been true, it would have cast serious doubt on one of Darwin's most important conclusions: namely, that man belongs to the Old World Division of the manlike apes, and did not cross to America until many centuries after he had reached man's estate.

MR. MOK: Are there any other real fossil men?

DR. GREGORY. Several. The most recent find is the so-called Peking Man, and it is probably the most important so far. As a matter of fact, there are two. One skull was found in December, 1929, and a second only last year. The discoveries were made by a group of students exploring a cave thirty-seven miles southwest of Peking, China, under the direction of Dr. Davidson Black, professor of anatomy at Peking Union Medical College, who had just issued a great scientific book on the subject. There is a pretty little romance connected with these skulls.

MR. MOK. A Chinese Ice Age romance?

DR. GREGORY: Yes. One of the skulls is that of a young man, and the other that of a woman.

MR. MOK: Do *(Continued on page 136)*

HOW MAN-APES BECAME MEN

(Continued from page 135)

you suppose they really were man and wife?

DR. GREGORY: I rather like to think of them as the Chinese counterparts of Adam and Eve in their paradise. Originally, it was suggested that the skull that was found first was that of a young girl, but when a comparative study was made with the second one it was believed more probable that the first was a young male and the second a female.

MR. MOK: Why was this find so important?

DR. GREGORY: Because the structural characteristics of these thick and primitive but unmistakably human skulls absolutely vindicates the humanity of the Java Man, and tend to prove that the Piltdown Man really was one human creature. The brain cases are more advanced than that of the Java man. The jaws still are apelike, but the teeth are decidedly more human than those of the Piltdown Man. The Peking Man, as the two skulls are collectively known, moreover shows an intermediate stage between the Java Man and the Piltdown Man on the one hand, and the Heidelberg Man and the Neanderthal Man on the other.

MR. MOK: Who was the Heidelberg Man?

DR. GREGORY: He really is nothing but a huge lower jaw. The name derives from the fact that this remnant was found at Mauer, Germany, near Heidelberg. Though definitely in the manlike stage, he still is quite apelike in certain features. He was the first glacial man in Europe.

MR. MOK: What do you mean by "the first glacial man?"

DR. GREGORY: I mean that he lived in the first interglacial period. There were four Ice Ages. Picture them as a great seasonal drama in four acts, played over a period of a million years. Four times bitter winter descended on the world, spreading a vast ice sheet over the entire north of Europe and driving south the animals, with the exception of a few hairy mammals. With each retreat of the great ice sheet, the animals surged back north. The Heidelberg Man came in the first 'intermission,' which means that he lived from 500,000 to 750,000 years ago. All authorities agree that he was an ancestor of the Neanderthal Man.

MR. MOK: Were the Neanderthalers civilized?

DR. GREGORY: While they buried their dead and made fine stone implements, they still were very low in the scale of civilization. They were absolutely dependent on wild animals for food and clothing. The later Stone Age men, among them the Cro-Magnons, who lived about 20,000 years ago and left us mural paintings in the caves of southern France, were much more advanced. Civilization in our sense, however, did not really begin until people invented ways of storing up a food supply. In other words, it came in with agriculture and the domestication of cattle. These arts were perfected by three streams of invaders—one from the Mediterranean, one from the southeast, and one from the Baltic. These three races, roughly, are the direct ancestors of the modern white man, and you can recognize their definite characteristics in people today.

MR. MOK: How is it possible for definite characteristics, such as those of the Mediterranean and Nordic races, to be preserved and handed down for such tremendous stretches of time?

DR. GREGORY: Now you are getting onto the subject of inheritance, and that is another story.

WEIRD UNSEEN RAYS TRAP MASTER CROOKS

(Continued from page 35)

shade of the spot on the glove. The suspect was held, his activities traced, and he was later sentenced to a long term in prison.

At the Parini Laboratories, last year, it was announced that different races can be told apart by the fluorescence of teeth and bones. When the pulverized tooth material of Caucasians is placed under ultra-violet rays, Dr. Parini reports, a greenish glow results. That of Orientals gives a yellow tinge and that of Negroes a red-orange cast.

On August 7, 1930, he was given a chance to prove his theory. Cicero police dragged from the Chicago Drainage Canal the body of a man swollen beyond recognition. The skull had been crushed and the authorities wished to know if the killing was the result of a gang war or a tong outbreak in the Chinese section. So a tooth was submitted to Dr. Parini. Under his apparatus, the pulverized bone glowed with a yellow hue, showing the victim was an Oriental. Authorities later discovered he had actually been killed in the Chinese quarter and thrown into the canal.

TO AID the modern detective portable black light outfits that can be plugged into any convenience outlet are now available. Photographic equipment allows permanent pictures of clues as they appear under ultra-violet rays to be kept on permanent file. One Chicago manufacturer has placed on the market a violet light machine for installing in banks for examining checks and bills.

Erasures in "boosted" checks that are invisible in daylight appear instantly when held within range of the rays, and counterfeit bills bearing a sickly green imitation of the shaggy blue fluorescence of genuine currency stand out like a sore thumb. Tracing altered checks with rays, Dr. Goodman, three years ago, caught a skillful criminal who had mulcted one New York organization out of $180,000 in a single year. In a number of European banks, ultra-violet lamps are installed as part of the regular equipment.

Another place where these wonder-working rays have found new employment is in examining letters sent to and from prisoners. Secret writing about escapes or smuggling drugs or firearms becomes visible in black light. Formerly a hot iron was rubbed over suspected letters to bring out the secret words. Now such messages are read and the letter is allowed to go on to confederates outside who are caught when an attempt is made to carry out the plot. One common powder, aesculin, sometimes used in secret inks, responds to rays when it is so dilute there is only one part powder to five million parts water!

AT ONE laboratory I was shown a check that was signed five years ago with ordinary ink into which a slight amount of this white powder had been dissolved. Under the ultra-violet lamp, this old signature stood out as though written with radium. By thus adding a small quantity of this easily-obtainable powder to the ink in your fountain pen you can outwit the cleverest forger!

So far, the giants among the detective rays have been those of ultra-violet. But others are important too.

Recently, polarized light—rays that have passed through prism screens and are vibrating in one direction only—has figured in a number of dramatic cases. Used with the petrographic microscope equipped with a special lens, a *(Continued on page 138)*

WEIRD UNSEEN RAYS TRAP MASTER CROOKS

(Continued from page 137)

rare instrument which only a few experts can handle, it is now doing remarkable work in tracing dust and minerals. Seen through this microscope, each mineral has its strange distinctive pattern or interference figure.

THE greatest triumph for this microscope, and the mysterious "one-way" light which makes its use possible, occurred recently. A middle-western farmer started on an auto trip with his son-in-law. The machine was found overturned on a lonely road, the old man, his skull crushed in, lying at the foot of a bloodstained rock.

The son-in-law, who was uninjured, said he had leaped clear just as the car turned turtle, but that the older man had been thrown from the machine, hitting his head on the rock. This story was accepted until a few days later when it came out that a large amount of accident insurance had just been taken out by the old man.

Authorities investigated. Finally, polarized light, in the hands of an expert with a petrographic microscope, revealed that the overturned car and the bloodstained rock were carefully planned links in an atrocious crime. Bits of broken rock, extracted from the head of the victim, cast an entirely different pattern from that given by pieces chipped from the bloodstained boulder. Confronted with this evidence, the son-in-law confessed that he had killed his victim.

IF YOU mention the use of rays in crime detection, most people will think of solid piercing X-rays, which often play a part. In laboratories where these penetrating vibrations stream from glowing tubes, frauds and plots are often exposed. Here, fake paintings are detected and spurious gems revealed. Imitation sapphires and rubies can now be made synthetically so they have the same light refraction, the same chemical composition, and even the same atomic construction as the real gems.

The only way to tell them apart, a German physicist has just announced, is to place them under powerful X-rays from a Coolidge tube. If the stones glow, they are genuine.

In the moat of an ancient fortress near Copenhagen, Danish police, not long ago, found the legless body of a woman. Extensive search among the records of missing persons failed to identify her. The police decided to have the body X-rayed. One lung proved so badly infected with tuberculosis that they concluded the woman must have been a patient at some hospital.

A search of all hospital photographs followed. The X-ray record of one woman's lung so closely resembled that of the unknown victim that they followed up the clue. When they arrived at the address from which the hospital patient had come for treatment, they learned she had left two weeks before. Undaunted, they examined the furniture and found old fingerprints. These matched exactly those of the murdered woman. Sure of her identity, the police pressed on the trail, found a man with whom she had been associating, and obtained from him a confession.

HOW the test tube in the hands of a chemist beats Sherlock Holmes in finding the crook will be told in the next installment of this fascinating series. It will give you the latest in research, the newest in discoveries. You should not miss its thrilling stories of criminals bagged by the modern magician. Watch for the November issue of POPULAR SCIENCE MONTHLY *on sale Oct. 1*

RAZOR BLADES AND SHAVING

(Continued from page 55)

razor. Only honing will do that for a blade.

The investigation also proves that no matter how carefully you clean and strop your razor after use, the vital cutting edge will rust away and the razor will become dull unless the edge is protected from the moisture in the air by oil or grease.

More than $35,000,000 is spent each year for safety razor blades in the continuous war against whiskers. Over $1,250,000 goes into new safety razor frames to hold these blades, and $300,000 is the amount still spent each year for straight razors such as barbers use. How many of these razor edges are nearly perfect when new and how many will slice through an adequate number of tough whiskers? How many of them are made of steel tough and strong enough to stand many strippings?

IT IS quite impossible for the average buyer to determine anything about the quality of the material in the razor or safety blades he buys—except by actual trial on his own beard. The composition of the steel, the care used in its manufacture, and particularly the care used in the subsequent heat treating and sharpening govern its usefulness as a razor.

None of these qualities appear in the looks of steel as felt to the touch, or the appearance of the finish. It is possible to finish a piece of steel in quality no better than pot metal so that it looks exactly like the finest razor ever made. Every razor buyer must therefore depend on the manufacturer's reputation.

Given a good barber's razor or a supply of good safety razor blades, how should the shaver care for the cutting edge so as to derive the maximum number of satisfactory shaves at the minimum of expense and trouble?

As the photographs of highly magnified razor edges show, the first and most important step is to keep the cutting edge clean and well oiled or greased, when not in use.

It is, of course, common practice for users of straight barber's razors to strop the cutting edge between shaves, but few self shavers can do this as well as the professional barber.

AN INVESTIGATION of the barber's technique in stropping a razor reveals some rather startling facts. Each barber seems to have his own ideas about what strop to use and how to do the stropping. You will find barbers using strops ranging from the palm of the hand through horse skin, canvas, and treated roan to buffed rawhide.

The fact that barbers using these and many other substances for strops get good results seems to indicate that any of them may be used provided the stropping is carried out in a careful and workmanlike manner.

Stropping a safety razor blade presents exactly the same theoretical problem as does a barber's razor. The blade being in most cases only slightly thicker than a piece of paper, there is no shank to serve as a guide to the proper angle. The solution is to use a mechanical stropping device that will hold the blade at the proper angle.

In the course of the photographic research into razor blade phenomena it was found that the more efficient of the mechanical strappers are so made as to permit an adjustment of the tension and give a diagonal stroke which permits the various portions of the cutting edge to come into contact with different parts of the leather disks or rollers. It was also found (Continued on page 140)

RAZOR BLADES AND SHAVING

(Continued from page 139)

that the mechanical stropping devices designed for use with standard or modified standard razor strops give about as good results as the best of the mechanical devices.

When a razor blade becomes so dull that stropping is no longer of any value, then the blade must be honed. Honing is a grinding process carried out on specially fine stones. This process is not worth while for safety razor blades—new blades are too cheap. The hone itself can be of several different varieties of either natural mined stone or artificial stone.

It is obvious that any shaver who wishes to do so may hone safety razor blades with equal success provided a fixture is built that will hold the blade at exactly the right angle. If the blade is held between the fingers at what seems to be the right angle the results are not likely to be satisfactory, as a slight trembling of the fingers in moving the blade across the hone is sure to produce a rounded edge that will not shave properly.

The photographing of hundreds of safety razor blades of various makes proves that there is a definite difference in quality both as to their original sharpness and their ability to stand up under constant use. Furthermore, it has been found that there is a considerable difference even between blades of the same make taken out of the same package. That is why some blades give more shaves and better shaves than others.

Steel is after all only a mixture of iron, carbon, and other ingredients, and although the better razor and blade manufacturers take elaborate precautions to keep their product as nearly uniform as possible in a process so delicate tiny variations are bound to occur. Such variations have big effects, as the 2,000 diameter photomicrographs prove.

In the hustle and bustle of trying to get to work in the morning, shavers are apt to forget the importance of careful lathering in shaving. A barber's razor made fifty years or more ago constantly reminded its owner on this point, for neatly etched on the side of the blade were the words "You lather well and I'll shave well!"

TELESCOPE AID IN WAR THOUGHT GALILEO

BUILDER of the world's first telescope visioned it primarily as useful in war. This was disclosed when a letter written by Galileo Galilei, famous Italian physicist and astronomer of the sixteenth and seventeenth centuries, recently came to light in New York City. Writing to Cosimo de Medici, Galileo told how he had improved the telescope, and said, "The telescope was made for the most accurate study of distances. It has the advantage of discovering the ships of enemies two hours before they can be seen with the natural vision and to distinguish the number and quality of the ships and to judge their strength and be ready to pursue them, to fight them, or to flee."

RAVENS FLY ON BACK

Aviators are not the only ones who fly upside down. Recently observers reported having seen large flocks of ravens in Iceland, where the birds are plentiful, in inverted flight for distances as far as a thousand yards. These upside down flights are seen most often at the time of courtship, when the birds indulge in air acrobatics.

MAN'S ENDLESS FIGHT FOR WATER

(Continued from page 43)

would bear the weight of a column of water a square inch in area and 100 feet high. The concrete conduit which was strong enough on level ground, would burst under the tremendous force of water going down into a valley. To prevent this they built U-shaped sections, called "inverted siphons," of powerful steel.

At other places along the line, five hydro-electric plants were built to send their current to the city.

The system was completed in 1913, and it will have been outgrown in just twenty years. This time it is not the weather's fault. It is because more people have decided to congregate near Los Angeles.

But the city will be ready. It has dug 100 wells in Owens Valley, and set about catching all the water that flows there. This will postpone the threatened shortage until 1936.

BY THEN another emergency job is to be completed. In the Mono basin beyond the divide that shuts in the far end of Owens Valley, four streams carry the rainfall away in the opposite direction. Los Angeles intends to get that water. An open canal is to be dug, crossing the four streambeds and leading the water out of them into a dammed-up lake.

A tunnel is to be driven eleven miles through the divide. Through this bunghole, the basin will pour its water into the upper end of the Owens River, whence it will flow down the river channel to the reservoirs and aqueduct—and save Los Angeles from water famine until the Colorado River line can be completed.

Los Angeles more than most cities, has recognized the importance of water. Its inhabitants have made it a garden spot largely by their own efforts. Most of its greenery and flowers are symbols of human victory in the struggle against drought.

The famed climate of the region is dry. In a normal year the rainfall at Los Angeles is only 15.2 inches. That is less than two-thirds the amount that fell on Maryland in 1930, and Maryland headed the list of drought-stricken states, with only 56 percent of its usual rainfall.

A CURIOUS fact stood out in the country as a whole. Of the eight states that reported normal rainfall or better, seven had less than hard-hit Kentucky. It was the unexpectedness of the drought that caused the crisis.

The water supply engineer estimates a city's needs many years ahead. He studies the records of the supply that is to be used, and satisfies himself that in the longest dry periods, it will be safely in excess of the community's greatest demands. But in many localities 1930 and the early part of 1931 set new standards.

Sudden emergencies were created.

At Lexington, Ky., ordinarily the rainfall on twelve square miles of watershed, is sufficient to supply the city. During 1930 there was a deficiency of 18.5 inches. An inch of rainfall over a square mile of area amounts to more than 17 million gallons. The Lexington watershed received about four billion gallons less than normal.

In the fifth month of drought, the reservoirs were nearly empty. The city forbade the sprinkling of lawns, washing of autos, and all unnecessary use of water. Ordinary human needs had to be met. A reserve had to be kept to guard against fire.

Officials were alarmed. The Lexington Water Company, under the supervision of the Community Water Service Company, laid a twenty inch *(Continued on page 142)*

MAN'S ENDLESS FIGHT FOR WATER

(Continued from page 141)

pipeline to the Kentucky River, seven miles away.

But a cliff-like hill rose 385 feet above the river's edge. Building the pipeline down that hillside and lifting the water over it gave engineers a problem. It had to be solved quickly.

The slope was so steep that a surveyor who had gone out to chart the route, had fallen and lost his transit. A ladder had to be built down the side of the hill so workmen could keep their footing. Concrete for the foundations was shot down from the top through a closed trough. Rather than risk lowering the six-ton motor and pump down the precipitous slope, the engineers had them hauled to the river at a point miles away and brought to the foot of the pipeline by boat.

Then came another problem. The Kentucky River was known to rise and fall suddenly as much as forty feet. The main pump had to be out of reach of flood; but with the river at low level, it could not suck up the water. The theoretical limit of water suction is about thirty-three feet, but in this case the practical limit was considered nearer twenty.

THE engineers set the pumping station on the hillside out of reach of floods. A railway track was built down the steep forty-foot slope to the river. A special light pump was installed in a house on wheels, so that it could move up and down the track, keeping always at the water's edge.

This "toonerville trolley" was connected with the main pump by pipe made up of ten-foot lengths that could be taken out or added quickly. The last length was of massive rubber hose.

An eleven mile transmission line had been built to bring electricity. The light pump lifted the water to the main station on the hillside. The heavy pump there forced it the rest of the way up the slope. From the top it flowed by gravity to the almost empty reservoirs.

Lexington was saved from water famine and possible disaster.

Carlinville, Ill., got water by dynamite. They had a dam across Macoupin Creek, but the stream ceased to flow. In its bed were ponds of still water. The dynamite blasted a channel for the water to run down to the dam.

Some localities were threatened with epidemics of disease, because there was not enough rainfall to carry away the sewage and filth that lingered in sluggish streams and seeped through the parched earth toward wells. The state of Kentucky sent out typhoid serum for a million people.

THE full forces of engineering and science were mobilized to repulse the invading germs that came with the drought. Chemists and bacteriologists were the sentries; they tested water supplies everywhere. Filtration plants were forts to halt the invisible enemies. Ultra-violet rays bombarded them. Chlorine and ozone gassed them.

All over the world and all through history there have been occasions when men fought each other for the possession of water. Drought and the needs of growing populations have served alike to make limited supplies precious.

Two opposite extremes of the struggle were emphasized by events this year.

While hundreds of persons were reported dying of thirst in the deserts of Syria and Arabia, tribesmen waged a fierce battle for a well. More than fifty men were wounded and many were (Continued on page 143)

MAN'S ENDLESS FIGHT FOR WATER

(Continued from page 142)

killed before the water war ended.

In the United States, at the same time, a different kind of fight was being waged. It was for billions of gallons of water flowing into the Delaware River. The states of New York, New Jersey, and Pennsylvania, had conflicting claims. Supplies were involved for New York City, and at future dates for Philadelphia, and other cities.

Unlike the desert tribesmen, the people for whom the Delaware River water was intended, did not journey miles across the country to reach it. Many of them did not even know it was being fought over.

Engineers went out to bring it to them. Rival technicians of the three states clashed. The weapons, instead of knives and guns, were figures as to the needs of cities, and the supplies available on the watersheds from which they were to be drawn.

The conflict started when New York City, anticipating a shortage, planned a ten year building program to bring water from several new sources. The water was all in New York state. But ordinarily emptying into the Delaware River, it flowed to New Jersey and Pennsylvania.

EVENTUALLY, it was realized, the location of industries and the homes of millions of people might depend upon whether the water followed its natural course down the Delaware, or whether it was taken through tunnels and aqueducts to meet New York City's needs.

The fight went to the supreme court of the United States. The court fixed the amount of water that could be taken. When the Delaware River falls below a certain stage, New York City must feed it with water released from her reservoirs. Future needs of the various cities are to be settled by the court.

A river, the court said, "is a treasure." It "offers a necessity of life that must be rationed among those who have power over it."

Even unseen groundwater, flowing beneath the surface, is the subject of disputes. Engineers estimate its quantity and its direction of travel by the dip of rockbeds, the speed of the water's flow, and the yield of wells.

When New York City planned to supplement the water it receives from several hundred wells, by drilling more in certain parts of Long Island, other communities protested hotly. Engineers had warned them that the new wells would intercept the groundwater as it flowed toward them, and imperil their own supply.

Sometimes the worst difficulties met in providing ample water supplies, are floods.

Oklahoma City thirteen years ago rid itself of almost annual water famines, by the building of a large storage dam; and the only threat of shortage since then, came as the result of too much water.

THE dam joined a natural earth embankment stretching across a broad valley of the North Canadian River. During a flood, the river overflowed the earth wall and cut a passage through which most of the stored water escaped.

With the flood swirling through the hole, the dam itself held. The builders, the Ambursen Construction Company, were engaged to close the door. The size of the spillways was increased so future floods could pass more quickly and less angrily.

The volume of flood water that can flow over them now is as great as Niagara Falls! This Oklahoma City dam is equipped to get rid of enough water in four days to supply New York City with water for a year.

The North Canadian is a river of extremes. It was so shallow during part of the work on the original section of the dam, that the builders shoved it out of its regular bed into a new channel, in order to make construction easier.

The same builders used an even more interesting method to avoid the bother of water during part of the work on the Rodriguez dam near Tijuana, Mexico. They built a temporary dam across the channel. They virtually told it, "Stop! Men working!"—and sent it on a detour through a conduit ten feet in diameter which easily held all the water.

The dam is being built for the Mexican government, to save water for a rainless day. The rainless day may last, with varying severity, as long as five or seven years. The reservoir will supply water for irrigation and community use.

EVEN cities with seemingly easy supplies, sometimes encounter difficult problems. Cleveland and Chicago, situated on the shores of lakes, found that there was danger of pollution in the water close to land. To escape the risk, they built intake pipes four and five miles out into the lakes.

Sometimes apparently intricate devices solve a city's problems easily and satisfactorily. Naples, Italy, dug five parallel tunnels in the gravel thirty feet underground. These tunnels, called "infiltration galleries," extend 2,000 feet. Groundwater flows into them rapidly, and Naples pumps out thirty-eight million gallons a day for her two million inhabitants.

Early civilizations had developed elaborate systems. More than four thousand years ago, the waters of the Tigris and Euphrates Rivers in Asia, were being carried in canals to many cities. Ancient China had astonishingly deep wells. Egypt had open canals, chiefly for irrigation. In Alexandria, Egypt, the overflow from the river was caught in cisterns beneath the houses, and drawn out in buckets through the rest of the year. Parts of stone water channels still exist in Peru, as striking remains of the lost civilization of the Incas.

Rome had fourteen aqueducts, some of them more than fifty miles long. Sometimes closed channels were made of solid blocks of stone, each block pierced with a huge hole, through which the water passed. Some of the conduits were carried for long distances across valleys, on the tops of walls supported by high columns. Under Roman dominance, aqueducts were built for two hundred colonial cities.

ATHENS today receives part of its water through a rebuilt aqueduct, 1,800 years old. After being forgotten for hundreds of years, it was discovered in the last century, and put back into use. Recently an American firm was engaged to make further enlargements of the supply system, to keep pace with the enormous growth of the city which followed the influx of Greek refugees from Turkey.

Scientists, studying the ruins of lost cities in the Peruvian Andes Mountains, have sent out word that failing water supplies or impurities in the water, probably were largely responsible for the collapse of the ancient civilization there. A plague is believed to have killed many of the inhabitants; then the difficulties with the water forced the survivors to abandon their towns and farmlands. The scientific explorers found the remains of a cathedral and other buildings that probably were constructed before the discovery of America.

When the camera looks . . .

through this quartz window—

Knocking Gasoline must CONFESS!

ENGINEERS can now *watch* gasoline burn. A quartz window sealed into the top of the cylinder tells their eyes—or their camera—the full story.

A photograph of ordinary gasoline shows a smooth burning *up to a certain point*, then a quick explosion of the remaining gasoline vapor. Instead of pushing down the piston smoothly, much of this remaining power is wasted in the knock, causing overheating and vibration.

A photograph of Ethyl Gasoline shows all the vapor burning steadily. The power is released in one smooth downward pressure just as the piston is in position to use it. Controlled combustion gives maximum power without wasteful overheating, vibration or harmful knock.

The camera reveals these two types of gasoline combustion. One or the other of them is happening in your car every time you drive it. Get the power out of gasoline that is there—the power out of your engine that it was designed to give. Fill up with Ethyl and enjoy the sweeter, more powerful motor, the better performance of Ethyl's controlled combustion. Ethyl Gasoline Corporation, Chrysler Building, New York City.

Gasoline has always hidden behind iron walls for the most important act in its life. But now engineers have lifted this cloak of mystery. The difference they see between the smooth combustion of Ethyl Gasoline and uneven explosion of ordinary gasoline is astounding.

The active ingredient used in Ethyl fluid is lead.

ETHYL
Controls Combustion

ETHYL GASOLINE

S.S. East Indian and Lake Ormoc, of the Ford Fleet

DESTINED FOR DETROIT

IN THE DAYS when the life and energy of New England were expressed in terms of sailing-ships and adventurous voyaging, the little port of Salem meant more to the people of Malaysia than all the American Colonies together!

Today, though few think of Detroit as an ocean port, cargoes from the farthest corners of the earth find their way by sea and river, canal and lake, railroad and highway, to the docks at River Rouge. At East African ports, ships are piled with red ore of friable chrome destined for Detroit. Rare varnish ingredient comes from Formosa. Diamonds, even, are in the cargo from South Africa. Rubber and nut-oil come from the Yangtze, the Amazon, and ports of the Malay States. Better known than Salem ever was, Detroit, today, typifies America.

All the world contributes to the making of a Ford! For all the world is searched to find the best of raw materials to manufacture this famous car. And all the world receives back again an automotive unit of transportation that brings a new idea, a new stimulus, to the service and well-being of mankind.

The Ford principle has always been to produce the best possible car for its purpose, regardless of cost; and then, by applying the highest degree of efficiency and the most painstaking economy, to bring the cost of its production down as far as possible.

Materials arrive at Detroit, by railroad, truck, steamship and airplane under exact co-ordinated control. Wherever it has been found necessary in the interests of better speed and consistent economy, Ford has realigned and created systems of transportation to further reduce the ultimate cost of manufacture.

As far places contribute to the production of the Ford automobile, civilization gains by its use.

FORD MOTOR COMPANY

GOOD . . they've got to be good!

Fred and Adele Astaire in Broadway's musical hit, "The Band Wagon"

Darn good—you'll say!

Everybody wants a mild cigarette. And when you find one that is milder and *tastes better* too—you've got a smoke! Chesterfields are so much milder that you can smoke as many as you like. Mild, ripe, sweet-tasting tobaccos — the best that money can buy. That's what it takes to make a cigarette as good as Chesterfield. And the *purest* cigarette paper!

Every Chesterfield is well-filled. Burns evenly. Smokes cool and comfortable. *They Satisfy* sums it all up!

EVERYBODY'S GETTING ON "THE BAND WAGON"